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LONDON TREATISE ON THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

We are informed that the above work will be completed in *about* twenty four numbers and extend through about two years. No one in the business should be without it. To those who have not ordered it we would suggest that they send, at once, names and address. The first three numbers have been forwarded to those who ordered them early. To others the back numbers will be sent, and the work will come regularly every month. Price forty cents a number. Bills will be sent in due time.

THE ANNUAL MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

The VIth Annual meeting of this Society was held in Boston, on Wednesday, the 21st ult., and the attendance was unusually large. Mr. Geo. D. Cabot, of Lawrence, Massachusetts, having positively declined re-election to the office of President of the Society, which he has so admirably filled for several years past, Mr. Samuel G. Stiness, of Pawtucket, R. I., was elected his successor, and the other officers of the Society will be found in another column.

The selection of Mr. Stiness has secured for the Society's Executive a gentleman of well-known ability, of directness of method, and fixedness of purpose, and one who, we doubt not, will see to it that the objects and purposes of the Association are strictly adhered to, and that nothing is left undone, to promote its interests, that lies within his legitimate province to perform.

The meeting just closed was deemed by all those present to have been one of the most successful that the Society has ever held. Papers were read upon various topics connected with the business which we shall publish in their regular order. There was one upon the subject of the "Heats of Benches," by Mr. Malcom S. Greenough, of Boston, which will probably attract considerable attention, as it embodied a tabulated statement of the results of a large number of experiments to determine, as nearly as possible by careful investigation. the actual heat attained by different retorts during the various stages of carbonization in a 24-hours running; and giving, in connection therewith, the yields that resulted from the different heats, and the percentage of coke used in attaining them. This is a matter that perhaps many may have experimented upon; but we are not aware of any printed report, in the English language, of actual testings of temperatures. While Mr. Greenough does not, in his paper, claim any originality as to methods pursued for determining these temperatures, still he has presented a series of facts which we believe present several novelties. First—the facts, as such, themselves. Second—the care and perseverance with which a long series of experiments have been conducted in the interest of the profession, with a view not of refuting somebody's theory, but of forming a basis upon which a true theory may be constructed.

This is a matter which is being much discussed just now in connection with retort settings. One party advocating heavy settings to store up caloric, another claiming that light settings allow the direct action of the fuel in the performance of the work assigned it.

Mr. Malcom S. Greenough's paper will be given in full in the course of the publication of the proceedings, and we trust that others will be induced to make similar tests, by the *same methods*, as are described in full therein for the purpose of comparison. Other papers were read and discussed by Messrs. Lamson, of Boston, Mr. Sherman, of New Haven, Col. Armington, of Brooklyn, and others.

Another new departure, as we deem it, in the right direction, was the offering of a prize for the best paper upon any subject connected with the manufacture of illuminating gas, the principal material being coal, to be given to that member of the Society whose paper should be judged worthy of it by the Executive Committee. The retiring president, Mr. Geo. D. Cabot, of Lawrence, also made an offer of a prize of $50 to be given for a similar purpose.

The Society elected Gen. Charles Roome, of New York, and Mr. Geo. W. Edge, of Jersey City, honorary members, in consideration of the many valuable services they had rendered the profession in the many years they have so untiringly devoted to the Science of gas making. This is the first instance in which any one has been elected to honorary membership since the organization of the Society; and in the selection we believe they have but paid a fitting tribute to two of the best men in the business.

The Society did another thing which will do more to enlarge its usefulness than any thing else they have done before, viz.—A resolution was passed by which statistics of practical workings are to be collected each year for the benefit of the members. The information to be thus obtained has been often referred to in these columns

as of the first importance in securing a basis for comparison of results; and we were glad to see that the matter is to be put in such form as will make it acceptable to all, and that, in all probability such useful information will be collected as will make the proceedings of the Society of permanent value.

In the evening the members sat down to an excellent dinner, at the Tremont, where the best of good cheer and good feeling prevailed.

The whole meeting was characterized by an earnestness and attention to business that speaks well for the efficiency of its management; and it was evident, from the harmony and good feeling that prevailed throughout, that the Association has a bright and useful future.

NEW GAS FIXTURE ESTABLISHMENT.

One of the most complete and elegant establishments in the business has just been erected and occupied by Mitchell, Vance & Company, at No. 836 Broadway, New York. The building stands upon the site of the residence of the late Judge Roosevelt, near 13th street, and is one of the most substantial and beautiful on Broadway, with an extension running through to 13th street. The entire building is occupied by the firm for the transaction of their extensive business. Fixtures of every variety may be seen here, from the plainest and simplest to the most ornate and costly. Especial attention is paid both to beauty of design and thoroughness of workmanship. The large facilities possessed by this house for doing work in the best and most economical manner, enable them to supply every demand with promptness and satisfaction; and, to all who are engaged in the supply of gas fixtures and their various accompanyments, we would certainly urge a visit to this establishment before completing purchases elsewhere.

PUBLIC LAMPS IN NEW YORK CITY.

At the office of the Commissioner of Public Works, on Thursday, March 1st, bids were to have been opened for the lighting of the public lamps, for nine months from April 1st.; but owing to the illness of Mr. Allan Campbell, the Commissioner of Public Works, he was not present, and the bids which were presented will not be opened until Monday, the 5th inst.

A New System of Gas Purification.

By R. H. Patterson.

My new system of gas purification is now so well known that I would not describe it here, however briefly, but for its direct inseparable connection with the question of "utilising spent purifying material," a most important subject, which I propose to deal with subsequently. The new system, which applies to the working of scrubbers and washers as well as purifiers, although I shall only speak of purifiers here, turns as the cardinal point upon the importance of the previously neglected carbonic acid in the crude gas, and the conversion of that substance from a fatal obstructive into a precious adjutant in the work of purification; and the chemical principle which I employ for this purpose is the superior affinity which carbonic acid possesses for lime and other alkaline substances, compared with sulphuretted hydrogen. At first, lime absorbs both CO_2 and SH_2 simultaneously and indiscriminately; but as soon as the lime becomes saturated with these impurities the CO_2 in the entering proceeds to expel the SH_2 converting the lime wholly into carbonate of lime. And by turning to practical account this superior affinity, I am able to remove the whole of the CO_2 in the first purifier or purifiers, in such manner as simultaneously to expel and drive forward the SH_2 into the subsequent purifiers, by which means the sulphur in all forms (both SH_2 and bisulphide of carbon) is removed in vessels into which no CO_2 enters to disturb or destroy this adsorption of the sulphur impurities.

For example; formerly, when the lime purifiers were used no testings were made for CO_2, nor was any attention paid to the action of this constituent of crude gas, although at this stage of purification there are no less than three times as much CO_2 in the gas as there is of SH_2. The consequence was, at the best, that the CO_2 went forward more or less through all the purifiers, the lime being three-fourths carbonated and only one fourth sulphuretted; or when oxide of iron was used after the lime, it frequently occurred (no notice being taken of the CO_2) that the whole of the lime was carbonated, and thereby rendered totally inert upon the sulphur impurities in any form—the SH_2 upon such occasions being taken out solely by the oxide of iron, and the whole of the bisulphide of carbon being left in the gas. The old system, in truth was only fitted to remove the SH_2 (and even this was done in a somewhat hap-hazard way), and was quite inadequate for anything more.

Under the new system, on the other hand, the closest attention is paid to the carbonic acid, regular testings for it being made; and the lime purifiers are now worked as follows:

They are employed either in two series, or as follows:

They are employed either in two series, or as two divisions of one series, the first set, under all circumstances, being employed to take out all the CO_2 and the second set to take out the sulphur in all forms. Say that four lime purifiers are employed in constant action, then the CO_2 is never allowed to pass beyond, say, the second purifier, hourly testings of the gas for CO_2 being made, and as soon as this substance appears in the gas issuing from the 2d purifier, No. 1 is thrown out of action, No. 2 becoming first in the series, while No. 2's place is taken by some other purifier, the contents of which are capable of absorbing CO_2.

It is important to notice this last phase. It must be remembered that, since carbonic acid has a greater affinity for the lime than sulphuretted hydrogen, has, it follows that lime is still capable of acting, and does not become inert in gas purification *until it is completely carbonated.* A lime purifier which has been thoroughly saturated with the sulphur gases still remains perfectly capable and efficient for absorbing carbonic acid—the sulphur, however, being of course expelled from the lime in proportion as it becomes carbonated. Accordingly my system can be, and is, worked in two ways, (1) either particular or what may be called *fixed* purifiers are used constantly as decarbonators, and others constantly kept as desulphurators, or (2) the whole purifiers may be worked as one series in rotation, each vessel being used in succession for sulphur and for carbonic acid. To put the matter clearly, suppose that each purifier bears a number of its own, say 1, 2, 3, 4. Then, under the former of these ways of working my process, the purifiers bearing the numbers 1 and 2 are used in rotation always and exclusively in removing CO_2 No. 2 becoming in turn first, and No. 1 recharged (or, which amounts to the same thing, a reserve purifier), becoming second; while the two subsequent purifiers, which are employed exclusively to remove the sulphur, rotate in a similar manner, namely, first as 3 and 4, and then as 4 and 3. Thus there is a double rotation, a separate rotation for each set of purifiers; the spent lime coming out of the first set wholly carbonated, and out of the second wholly sulphuretted.

Under the second, or alternative mode of working, no distinction is made as to the particular vessels, but only as to the object or purpose for which their contents are employed—the rotation being applied to the whole series of purifiers, instead of each set having a separate rotation. Thus, again supposing that the purifiers are numbered, No. 1, when carbonated, is recharged and placed last of all as 4, and so on with each in turn. But, while the rotation applies to the whole series—the last gradually advancing until it becomes first—the two purifiers which for the time stand third and fourth in the series are in that position employed to take out the sulphur in all forms, and thereafter, when they become 1 and 2, to take out CO_2. Under this mode of working, just as under the former one, the spent lime from the first set (1 and 2) comes out entirely as carbonate and from the second set entirely sulphuretted, or as sulphides of calcium.

In the case as here presented (namely, that the lime purifiers are of sufficient number that four can be kept in constant action) the latter of these two modes of working my process has no advantages over the former; on the contrary, it is inferior, because less simple. It is true there is an illusion about it on the surface, which has led some men to believe that by working the lime purifiers by this second or alternative course, whereby the sulphuretted purifiers are ultimately used as decarbonators, the *whole* of the lime can be taken out of the purifiers in the form of carbonate of lime. But this is a mistake. You cannot eat your cake and have your cake. If the lime purifiers are worked by rotation in one series, the sulphuretted purifiers (say 3 and 4) being moved forward so as to become 1 and 2, and so employed as decarbonators, this can only be done by wholly desulphuretting the lime in these vessels. Now the sulphuretted lime containing the absorbed bisulphide of carbon, must be taken out *somewhere* or other with all its sulphur intact. Therefore, when the purifiers are sufficiently numerous, it is better, because simpler, to keep certain purifiers, say 3 and 4, constantly appropriated in rotation to the work of taking out the sulphur, emptying No. 3 as soon as its contents become so highly sulphuretted as to be incapable of absorbing any more bisulphide of carbon; and in like manner appropriating in rotation Nos. 1 and 2 constantly for taking out the carbonic acid, emptying No. 1 as soon as it is fully carbonated.

But the case becomes altered if the purifiers be few in number—say only two lime purifiers in constant action, with oxide of iron last of all. It is needless to say that these two purifiers may be quite as efficient as three or four smaller ones; but the mode of working them, under my process may be advantageously modified, by working these two vessels in rotation together, instead of separately. It is quite possible to work each of them separately, viz., No. 1 for carbonic acid, and No. 2 for the sulphur—*i.e.*, emptying No 2 (instead of moving it into the place of No. 1) as soon as it is so highly sulphuretted as to be incapable of any longer absorbing bisulphide of carbon. But if this were done, it is obvious that there would need to be two *reserved purifiers*—one to put in action in place of the first purifier when it becomes fully corbonated and another to take the place of the second purifier when it be-

comes fully sulphuretted. Whereas, if the two purifiers in constant action be *worked together* (No. 2 becoming No. 1), then only one reserve purifier will be required. In this case also (viz., when only two lime purifiers are constantly in action and are worked together), the lime in No. 2 will not, and ought not to be fully sulphuretted before it becomes No. 1; and it will be maintained as No. 1 (*i. e.*, will not be emptied) until, but no longer than, it becomes fully saturated, and just up to the point when it loses its power to absorb bisulphide of carbon, owing to the CO_2 invading the sulphuretted portion of its contents. By throwing it out of action just at this point, No. 1 will retain all the sulphur (SH_2 and CS_2) which it has previously absorbed, but which would be expelled and lost if No. 1 were kept longer in action.—Of course when oxide of iron is used last of all the mere expulsion of the SH_2 from the lime does not matter, seeing that it will be subsequently arrested and removed by the oxide of iron; but this would be absolutely fatal to the removal of bisulphide of carbon (CS_2) the impurity which so long baffled the gas world and the removal of which is the primary object of my process.

Thus the only modifications in applying the new system if rightly used, as those above-mentioned, which are naturally dependent upon the number of purifiers employed; but, however worked, the *principle* of the process is uniform and unalterable, namely, to remove CO_2 first of all and in such manner as to produce pure sulphide of calcium, and also to any extent that may be required for the efficient purification of the gas from bisulphide of carbon. Never before has sulphide of calcium been produced in lime purifiers free from a large admixture of inert carbonate of lime, still less was there any known means of producing this pure sulphide of calcium to any extent that it might be required, or, indeed, to the extent that is required for the efficient elimination of bisulphide of carbon, a substance which is absorbed comparatively slowly, and which therefore needs to be passed through a correspondingly large quantity of purifying material.

Apart from this prime object of the new system of purification, viz., the removal of the long-existing sulphur difficulty, it possesses other concomitant advantages, the value of which will be readily recognized.

1. One of these is the increased facility which the new system affords for the utilisation of the spent purifying materials—a subject which I shall deal with separately.

2. Secondly, as to the diminution of nuisance from the use of lime. As already stated, the gas as it enters the purifiers usually contains three volumes of CO_2 for one volume of SH^2; and as by the new system the carbonated portion of the lime is obtained in and removed from the purifiers separately, and without any admixture of sulphuretted hydrogen and bisulphide of carbon, it follows that three-fourths of the whole of the spent lime comes out of the purifiers in an inodorous form, which cannot possibly be offensive either to the workmen or to the neighborhood. Thus all the sulphur is contained in one-fourth part of the spent lime; and although this portion being more sulphurous than before, is in itself more offensive than an equal quantity of the lime under the old system; nevertheless, owing to its small quantity, it becomes more easy to deal with it. It may be easily conveyed from the works in covered carts or tanks, the lids of which (like those of a purifier, for example) might drop down at the rim into a water seal, whereby the escape of effluvia would be prevented. Certainly it has happened that, although previous to my new system, lime could not be used in gas works situated within London—such as at the Fulham St. Pancras and Haggerston Works of the Imperial Company, and others—it is now freely employed in purification at each of those named works, and, indeed in nearly all the London gas werks however situated.

3. There is also direct and large pecuniary profit obtained from the new system, in consequence of the entire removal of the carbonic acid, whereby (as I have shown in a previous article) the illuminating power of the gas is greatly increased. It is true that the carbonic acid may be taken out otherwise; but, except by my system, it is impossible to take out the carbonic acid *and also the bisulphide of carbon*, the elimination of the latter impurity being now indispensable in properly purified gas.

In conclusion I may say a word as to the success of the new system as respects its prime object, namely, the removal of the sulphur impurity which had baffled the gas world for at least twenty years. The actual facts, as shown by official testings, are the most unequivocal demonstration of the success of the new process, but it is a pleasure to be able to quote a frank acknowledgement on the part of the gas world itself. As President of the British Association of Gas Managers Mr. Livesey, in his inaugural address in June, 1874, bore direct testimony to the success of my invention, adding that "Mr. Patterson in an official report, stated the thing so clearly that *no one has since pretended that there is any difficulty in reducing the sulphur compounds.*" In fact—as *e. g.*, at Bow Common—the "sulphur" can now be kept down to an average of five grains per 100 feet of gas, and with such complete control that during a whole month the amount of the impurity never varied beyond two grains—the minimum being 3.3 and the maximum 5.6 grains—average for the month, 4.4 grains. If this can be done steadily and continuously for a month, it can be always. In fact, gas can now be as thoroughly purified from the "sulphur compounds" (*i. e.*, sulphur in other forms than sulphuretted hydrogen), as it was from ammonia in 1869, in which year a maximum of five grains was first fixed by the gas referees for that impurity—which maximum, be it said, at that time was frequently exceeded.

Thus the new system has entirely fulfilled my statements in regard to it in 1872; and I think I may say, without any exaggeration, that never before has any improvement in gas purification combined in itself so many advantages.—*Engineering.*

Experiments upon Cements used in Holder Tanks.

La Compagnie du Gaz Parisien, previous to constructing some large gasometers near Paris, experimented on the different materials to be used in their construction; among others, on the cement which was to be used for the vertical walls of the reservoirs (*cuves*), with the following results: The cement used was Portland cement of Pouilly in Burgundy. It was found that a brick of pure cement six weeks old, which had been kept in water during that time, broke under a tensile strain of 170 lbs. to the square inch, 12 kilos. per square centimeter; but a brick six months old, which had also been kept under water, broke under a strain of 441 pounds lbs. per square inch, 31 kilos. per square centimeter; that cement hardens more rapidly, when exposed to the sunlight and fresh air, than when affected by humidity; but that this is at the expense of the tenacity and impermeability of the product; hence masonry walls should be sprinkled regularly until the cement has set; that the degree of fineness has an effect on the setting of cement, and consequently upon the ultimate tenacity, for it is a rule that the tenacity is in inverse proportion to the rapidity of the settings; that a mortar made of two parts sand to one of cement broke under a strain of 277 lbs. to the square inch, 19 kilos. per square centimeter, while a mortar of equal parts of sand and cement broke under a strain of 427 lbs. to the square inch, 30 kilos. per square centimeter. The effect of sand upon the shrinkage was shown by the fact that pure cement was defaced by cracks a little more than a foot apart; when mixed with equal parts of sand, the cracks were little more than a yard apart; when three parts of sand to one of cement were used, there were no cracks at all: hence it was this mixture that was used in constructing the reservoirs.—*Van Nostrand's*

Oechelhauser's System of Retort Settings.

It is a well-known fact that in the larger works in France, as well as in Germany, the temperature in the retorts is higher than in England, which naturally results in a larger supply of gas per retort per day. No doubt the German Continental Gas Company had reached, in this respect, the maximum, as may be shown by their annual reports read at the general meetings of the company, and published in different journals.

In the setting of six retorts, according to the enclosed design, the retorts are 8½ feet long and 14½ by 20½ inches in diameter, and produce from 50,000 to 60,000 cubic feet of gas in 24 hours.

In order to demonstrate more clearly to my brother managers the superiority and excellence of these retort settings, please allow me to give some figures of management, the true criterion of a good retort oven. They are charged, in regular working, every four hours, with a quantity of from 1800 lbs to 1900 lbs. of coals, which is adequate to a daily quantity of 108 cwts. of coals for the production of gas.

To obtain such results, the temperature must be raised to nearly a white heat. The quantity of fuel necessary for the extraction of gas from the above-mentioned quantity of coal daily is between 16 cwts. and 17 cwts.; or, to give here, too, some average numbers obtained by us—for every 100 lbs. of coal for gas making, 18 lbs. to 20 lbs. of fuel are required for firing.

The durability of these retort ovens, although worked at such a white heat, is no less than with others at a lower temperature, supposing the materials, retorts, bricks, etc., are of the best kind. —London *Journal of Gas-Lighting, Jan. 30th.*

Pontoon Bridges.—A new system of pontoon railway bridges now being introduced on the western rivers, consists in the construction and arrangement of a railway pontoon bridge, made in sections, of any suitable number and length, built above the surface of the water, from one to thirty feet in length or more; and it may be built on the deepest water without piers. It is prevented from moving by chains, anchors and windlasses. The whole bridge is provided with suitable railings and division between the foot paths and the center, where railrord tracks are laid for the passage of cars. Any section of the bridge may be removed to allow steamers to pass up and down, and is easily returned to position. This section is worked by a suitable engine and chains. There are ice breakers, either attached to the pontoon or separate, to protect the bridge during the winter season. Several are to be at once constructed along the Mississippi, between St. Louis and St. Paul.—*Iron Age.*

The Manufacture of Coal Illuminating Gas.*

By Alfred P. Trautwein, M. E.

Continued from page 66.

USE OF SPENT OXIDE.

One of the advantages of purification by means of oxide of iron and upon which its advocates lay considerable stress, is the ease with which the refuse material may be got rid of. As already stated, the purifying power of the mass may be regarded as being exhausted when the accumulated sulphur has reached 35 to 45 per cent. of the weight; in this state, however, the spent oxide is a very valuable crude material for the chemical works, and it is consequently employed quite largelyin the manufacture of sulphuric acid and Prussian blue.

En resume we will briefly enumerate the advantages and disadvantages which accrue from the use of iron purification. We note among the former as being most important:

First—That it completely removes all sulphur and ammonia, that is, to within a very small and unobjectionable quantity.

Second—The value of the spent material; it should be remarked, however, that a demand for this exists in few cases only.

Third—That it is a cheaper mode of purification than lime as regards its running expenses, though in in point of first cost lime is to be preferred.

The following, on the other hand, are some of the objections which are being urged against its use;

First—That oxide of iron does not eliminate the carbonic acid. This drawback, however, is partially removed by using hydrate of lime in connection with oxide of iron, each being contained in a separate purifier; the gas, thereby, is first deprived of its sulphur and ammonia compounds, and subsequently of its carbonic acid.

Second—Its detrimental influence upon the illuminating power of the gas, after having been in use for some little time and subjected to the process of revivification. This point was brought out very forcibly by a recent paper by Mr. Young on "The Manufacture of Illuminating Gas," and its subsequent discussion before the West of Scotland Association of Gas Managers.

Third—The obnoxious emanations from the revivifying house which render oxide of iron quite as objectionable, if not more so, than lime.

Fourth—Its liabiilty to spontaneous combustion, both when upon the revivifying floor and in the purifiers.

In addition to lime and oxide of iron, several other materials have been suggested as purifying agents. Thus, various salts of iron, manganese, etc., have been proposed from time to time, but their cost precludes their use.

In 1854, Bowditch suggested the use of clay, mainly as an auxiliary to hydrate of lime and for the purpose of removing the ammonia and sulphur. Subsequently, in 1860, he proposed to deprive the gas of its sulphur compounds through the agency of lime heated to a temperature of from 300° to 400° Fahr. He observed that hot lime has the power of so transforming the sulphur compounds, the bisulphide of carbon for instance, as to cause them to be readily removed by the ordinary lime purification. This process, however, involves so many practical difficulties that it has never been used successfully on a large scale.

Finally, it may be remarked, that several years ago, the late Dr. Letheby proposed the use of the so-called "soda waste" as a purifying agent, the main object being the removal of the sulphur compounds, and particularly of the bisulphide of carbon.

METHOD OF PURIFICATION HERE ADOPTED.

It will readily be seen from what has been said above, that the choice of purifying materials for our particular case will mainly lie between hydrate of lime and oxide of iron. In connection with the latter we might say that the second of its advantages, as enumerated above, cannot be said to apply in this case there being no special demand for the refuse oxide: the advantage, here referred to, is, as already hinted, a most important element in the success of any method of iron purification. At the same time its alleged economy is another subject in regard to which a great diversity of opinion exists; we have, for instance, frequently seen it stated that purification by means of lime is not more expensive than by means of iron, while some managers contend that the difference is from 40 per cent. to 50 per cent. in favor of the latter. We are, unfortunately, not in a position to speak with any degree of certainty in this matter, since no definite and reliable data could be obtained: we will, therefore, be restricted to the use of lime purification in the projected works. And, when the matter is examined more closely, it will appear that, after all, it is not so much a question of expense—for the cost of purification is but the smallest item in the cost of the gas—as of the completeness with which this purification is effected; and hydrate of lime, as we frequently had occasion to point out above, accomplishes this object very thoroughly. It is hoped, therefore, that these reasons will be considered quite sufficient to warrant our action. We may remark, at the same time, that the change from lime to iron purification can readily be made and without serious trouble and expense, if circumstances ever require such a course.

PURIFIERS FOR PROJECTED WORKS.

In designing the purifiers for the projected works regard was had to several considerations. In the first place that in all instances, at least four purifiers should be provided, three of which are in use at any one time while the fourth is having its fouled material removed and is being refilled with fresh lime; then again, it is very desirable that the purifiers shall not become "foul" too frequently, but rather one in, say every three days. If, finally, the purifying boxes are not made sufficiently large, that is to say, as large as possible and as is consistent with other considerations, a further disadvantage will be found in the fact that with a small purifier it is impossible to obtain results similar, as regards the amount of gas purified per bushel of lime, to those which are commonly attained in those instances where the purifiers are amply large. The reason for this will readily be seen when we consider that with small purifiers the velocity with which the current of gas passes through the purifying material is correspondingly greater than with large purifying boxes, and that, in consequence of this, the lime does not act upon the gas to its fullest capacity; for this reason it is customary to design the purifiers with a view to obtain area rather than depth.

Books of reference on the subject of lime purification contain a large number of rules and data for determining the size of the purifiers. They have been found to answer very well in the case of English and Continental works, but unfortunately none can be said to represent American practice; the gas coals of our own country and of the British Provinces are, as a general rule, much more sulphurous than are those to which these rules were designed to apply; then, again, they are all based upon stone lime as the purifying material, which, as is well known, has a purifying power very nearly twice as great as that of the shell lime so universally employed in this as well as in other sections of the United States. In the majority of cases, too, they may be regarded as having very little practical value from the fact that they are given in a very indefinite manner: they generally call for a certain number of square feet of tray surface for every 1000 cubic feet of gas to be purified in twenty-four hours, but, with one or two exceptions, no mention is made of the depth of the lime on the trays. Moreover, it is very doubtful indeed whether any fixed rule in this direction can be advanced with propriety; the amount of impurity which must be removed from the gas, depends entirely upon the coals employed in its manufacture, and these themselves have been found to vary largely in this respect, even when derived from the same mine. For these and other reasons the rules to which reference was made above, cannot be regarded as meeting the requirements of our particular case; we prefer, therefore, to base our calculations upon the number of cubic feet which a bushel of hydrate of lime can actually purify, distributing the lime upon the trays in a manner such as is demanded by the most approved practice. We might add that, in doing this we will be enabled to make use of the experience of a large number of works in this vicinity, using the same coals as here proposed, and in almost precisely the same proportions.

The following data, then, will form the basis for our calculations as to the size of the purifiers for the projected works. A bushel of shell lime when prepared according to the ordinary method weighs from 57 to 63 lbs. and has been found to purify on an average from 5500 to 6500 cubic feet of gas from our coals. It will, no doubt, be perfectly safe to assume the purifying capacity per bushel of the hydrate at 6000 cubic feet of gas, and at this rate the quantity of lime required during the time of maximum production will be 85 bushels per diem. Now, as already stated, the purifiers should not require renewal of their contents oftener than one in every three days; it is obvious, therefore, that each of the four purifying boxes—three of which are in use—must be made of sufficient capacity to hold 255 bushels of lime. The standard Winchester struck bushel contains 2150.42 cubic inches, and consequently each purifier must accommodate 548357 cubic inches of lime; distributing these upon seven tiers of trays, the depth of lime on each being two inches, the area of each tier will be 272 square feet. The purifying boxes in our case, therefore, will be 16′ 6″ in length, 16′ 6″ in width and 3′ 6″ in depth.

The box proper will consist of cast iron plates, ¾″ thick, bolted together by means of flanges, all joints being planed. The seven tiers of wooden trays will be supported upon a suitable framework of angle iron. The cover will be of sheet iron which need not exceed No. 11 B. W. G. in thickness, when properly strengthened and stiffened by means of T and angle iron ribs; it will be provided with the fastenings and attachments necessary for taking it up and holding it down and, finally, with a test cock by means of which the purity of the gas, and consequently the state of the purifiers themselves may be determined. The hydraulic cup along the edges of the box is cast with the sides; the maximum pressure to which the purifiers will be subjected is mainly that due to the holders and which, we will assume, will never exceed 8 inches of water; for this reason the dimensions of the cup will be 18 inches in depth and three inches in width. The connections for the purifiers will be 12 inches in diameter, this being the practice of several prominent engineers. The purifiers may rest either upon iron columns or stone piers and upon iron girders, in order to allow of ready access to the connections, etc. For lifting the purifier covers one or more carriages should be provided, travelling on rails laid either on the floor or supported overhead by means of lattice or other suitable girders.

CENTER SEAL.

In all works provided, like ours, with four purifiers, the mode of operation now about to be described is resorted to; for the sake of convenience we will designate the four purifying boxes as Nos. 1, 2, 3 and 4 respectively. The gas in the first place is passed through Nos. 1, 2 and 3 in the order here given, leaving No. 4 unused. The gas, upon leaving purifiers No. 2, is tested from time to time for sulphureted hydrogen by means of test paper prepared with acetate of lead; as soon as it shows the slightest trace of this impurity, the time has arrived for throwing out box No. 1 and bringing No. 4 into action. The gas now passes the purifying plant in this order: No. 2, No. 3 and No. 4. Purifier No. 1 in the mean time is being refilled with fresh lime, in order to be available for use as soon as No. 2 becomes foul; the purifiers, in other words, are thus worked in rotation.

* A Graduating Thesis at the Stevens Institute of Technology.

These several changes in the course of the gas through the purifying plant were accomplished for some time by means of a system of ordinary stop valves. Great care, evidently, had to be exercised in managing so many valves, and considerable responsibility was thus thrown upon the attendants. The necessity was, therefore, readily recognized of substituting for this system of valves, one which would be more simple and less liable to become deranged. For this reason several other methods of effecting the above changes have been devised; among others which have thus come into use, a very neat arrangement of six four-way valves may be mentioned, which greatly simplifies the valve system. But even this arrangement is not, as a rule, regarded as possessing sufficient simplicity for its purposes, and it is a general practice among gas engineers to employ the so-called center seal or valve. Each purifier is connected with this in such a manner that the course of the gas is as follows: Coming from the scrubbers it first enters the valve, then purifier No. 1, is then carried back to the valve and thence passed through purifier No. 2; and so on until it leaves the purifying plant at the center seal. In one of its forms it resembles somewhat the old hydraulic valve, inasmuch as the gas is compelled to take the above course through the agency of a number of suitable partitions in a drum which floats in a tank of water surrounding the mouths of the several connecting pipes; thus when it is desired throw out a fouled purifier and bring into action a new one, it is simply necessary to raise the holder sufficiently high until the several partitions no longer constitute a seal, then to turn the holder one quarter of a revolution, and, finally, to lower the holder until its diaphragms again dip into the water. This device, evidently, is not only as simple as can reasonably be desired, but it accomplishes its object most beautifully; accidents, so liable in all other arrangements, cannot possibly occur with this, since the course of the gas is changed, as we have seen in one operation; at the same time the fact should be borne in mind that this system is much more economical in every respect than that involving the use of several separate valves, while there is little or no liability of its getting out of order.

This form of center valve, however, is rapidly being superseded by the so-called dry center seal, which, though based upon the same principles, differs from the wet center seal just described in being much more compact; it is more expensive, however, since the joints between the diaphragms in the "bonnet" and the body of the valve proper, in order to be perfectly gas tight, must be carefully faced and scraped.

Notwithstanding the numerous and evident advantages of the center seal generally, we note a partial return to the system of separate valves in the case of the new purifying plant at the Newark, N. J. Gas Works.

[To be continued.]

Address of Mr. Price at the August Meeting of the New England Association of Gas Engineers.

[Continued from page 67.]

Having reduced the price of gas to two dollars per thousand we find it especially desirable to economise in every direction. We find we can burn the breeze left from our coke under our boilers, and now we make all the steam we use with a material which we have, in time past, thrown away. In this little item we save a dollar a day and, when winter comes, we will save much more by the utilization of breeze.

Speaking of economy reminds me of our attempt to utilize the ammoniacal liquor produced at our works, and what came of it. A German chemist undertook to work up our ammoniacal product, and we made such alterations as were necessary in order to give him the liquor of such strength as would enable him to work it profitably. Under the old system the liquor ran into a large tar well, and from that it overflowed into Lake Erie. We placed a large tank about 40 feet in the air. It holds a hundred barrels. This tank is so placed that its contents are easily run into the scrubber, which stands directly under it. The scrubber is thirty-three feet high and four feet in diameter. It is filled, from bottom to top, with wooden breakers so that the water in falling is diffused over a great deal of surface, with which the gas, in rising, comes in contact. From the bottom of the scrubber a drain pipe is laid to a tank which is placed in the ground, and from this the liquor overflows into another tank, and from this the clear liquor is pumped to the house where the ammonia is worked. Now, the ammoniacal liquor is lifted from the tar well up into the elevated tank, and from that it is discharged into the top of the scrubber and, having done its work there, it runs into the tank before mentioned, and from that, after depositing any tarry matter it may hold, it flows into the third mentioned tank, and from that it is carried to the ammonia works, as before mentioned. The liquor scrubs the gas more effectually than pure water would have done it, and by absorbing the ammonia from the gas it becomes strong enough to be worked profitably. The effect upon the gas is admirable—improving its illuminating power, and giving it brilliancy. We save something in water rent, and we get a few hundreds of dollars annually for the liquor.

Mr. Neal—Mr. Price, do you run the whole into a tar tank and the ammoniacal liquor rises to the top?

Mr. Price—Yes, sir; the tar and liquor run into a tar well holding 6,000 barrels—the tar sinks to the bottom, and the liquor rises to the top.

A movement has been made to save the ammonia produced in the larger gas works of our country. A company has been formed called the standard ammonia company, with a capital of $100,000, for the purpose I have indicated. It is in good hands; and I have no hesitation in commending it to the confidence of those interested. I do not suppose that any large amount of money can be saved by the gas companies, but I think it much better to save a little than to allow this item to be entirely lost.

Perhaps I have economy on the brain, but I scarcely think we can attach too much importance to a most rigid system of saving. The times are close, and there is a demand for gas at lower rates. Gas managers must study to produce good gas at the lowest rates. If this is done the public demand can be met, and yet fair dividends can be made.

I am asked whether some of the processes for making gas out of petroleum may not be useful. I answer that, in my judgment, all the patents, or all the processes, are liable to serious objections. It may be, however, that, under some circumstances, it may be expedient to use oil in making gas. Take, for example, a small town not having population enough to justify the erection of coal gas works. Oil gas is much better than either candles or lamps. A very small works for making gas from oil may be constructed for a little money. In such a case I should recommend the use of oil. I have never known a community that was satisfied with oil gas. The inevitable smoke deposits soot upon walls, and ruins frescoes and pictures. If air is used there will be blowing. I visited works at Reading, Pennsylvania last Autumn for the purpose of seeing oil gas, which was said to be free from objection. I went with the gentleman who superintended the construction of the works, and who thought them very complete. On leaving the cars we went down to the works and, in passing through the grounds, I saw several lanterns badly smoked. They have tried to overcome the difficulty by using small burners, but the smoke was there, and I am convinced it is a difficulty hard to obviate. The soot produced by oil gas is the meanest soot in the world. It sticks like oil and lampblack; it cannot be removed.

* * * * * * * * *

There is one point which is worthy of our attention. During the last session of Congress an effort was made to get permission to build opposition gas works in Washington. It was proposed to make gas from several materials, among which were wood, oil and water. The President of the Washington Gas-Light Company prepared two small pamphlets upon the propriety of using these materials, in which he maintained that they should not be used because the gas made from them, or either of them, contains a large proportion of carbonic oxide. He quoted scientific authorities in support of his positions. I was impressed by the argument, and think it well worth our attention. Probably you have seen Mr. Bartol's pamphlets. If any one has failed to receive them I have no doubt they can be obtained of Mr. McIlhenny the superintendent of the Washington Gas Works. I may add that the superintendent of the Toledo Gas Works is a practical chemist, and that he went to Detroit and made a chemical analysis of the wood gas. He sent me a statement of the result, which showed the presence of a very large proportion of carbonic oxide.

* * * * * * * * *

In answer to questions Mr. Price said—

If we had but one scrubber we should use it just as we now do two. The ammoniacal liquor, after it comes out, is of satisfactory strength. I am not certain as to its exact quality.

Mr. Price, in answer to a question—Petroleum was very high last winter; about $3·20 to $3·30 per bbl., of 42 gals.

I think I should continue to use it as enricher if it should advance to $4. The quantity we use is so small, in proportion to the whole material, that, even at a high price, the total cost of our gas is not much enhanced. At $4 I should use oil in preference to cannel coal. Darlington cannel costs us about $4·50, Peytona about eight or nine, and Cannelton cannel much more. As I said at the outset, I don't know the comparative cost of petroleum and cannel as enrichers, but I think I should pay as much as $5 per barrel for oil rather than use cannel.

There is another topic upon which it may be proper to say a few words. I refer to the reduction in the price of gas which my company made something over a year ago. Some parties have looked upon that step as injurious to the gas interest generally. I am sure we had no motive to injure our neighbors, and no inclination to do so.

Formerly we sold gas at three dollars per thousand. We commenced with the beginning of the second half of our financial year, to wit, on the 2d of June, and we have been selling gas to our general consumers at $2 for nearly 14 months.

The reduction to the public at large has given general satisfaction: the result, thus far, has been entirely satisfactory to our company. We never before collected our bills with so little trouble and annoyance. There is but very little scolding on the part of the consumers; in a word, we think we hit the nail on the head at the right time.

Our experience has brought me to this conclusion, that the gas business must be managed like any other business; that is, to say, we must get our labor and all our material as low as we can. We must economise both to the fullest extent—repress leakage and, in every way possible, reduce business expenses—and, in these ways, put our companies in such a position that we can make good gas at a low cost, and distribute it at a small expense. If we do these things we can meet the demand for cheaper light, and satisfy the public that new companies are not necessary because the old ones will deal liberally with the people. In my judgment the day has gone by when a gas company can make gas in almost any miserable, loose way, waste 25 per cent. of its product by leakage, pay extravagant wages to employees, and high salaries to officers, and still pay the stockholders liberal dividends. I do not know that I regret the change. Why should not the people have cheaper light if they can have it, and the companies still pay their dividends, simply by introducing economy, skill, and good judgement into the business?

[To be concluded.]

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—Ed.

Tar as Fuel.

New York, February 10, 1877.

Mr. Editor: In replying to the courteous invitation of "V" to continue my talk on the subject of "Tar as Fuel," and to tell "what I know about it," I wish to disclaim any intention or thought of imposing my "*ipse dixit*" on others. My desire is simply to arrive at the facts in the case and to fix the principles by which questions of this description should be solved. There are indeed many persons who appear to be influenced solely by the assumptions of, and the impressions made upon them by others, and not by the deductions of reason or the perceptions of a well balanced intellect; but I do not wish to communicate with such persons, and I know that the readers of the "Gas-Light Journal" do not belong to that class; I have too high an esteem for them, and for "V" himself, to write an article which may come under their notice, with such an idea or purpose in mind.

"V" says that I seem, from the use of the expression "fused carbon," to have adopted the views of Prof. Henry Wurtz that "carbon, like everything else, has a latent heat of fusion or liquidity," and that "oil fuel.....should yield us more effective heat than solid carbon in coal." The term *adopt* is hardly the proper one in this connection. I approve of those views and have reason to believe them to be correct; if such approval and belief is synonomous with adoption, well and good. It makes no great difference, however, but it seems to be best always to avoid the involving of ideas and to observe the natural distinction between things, be those distinctions more or less.

Let us see. All modern chemistries teach that there is a latent heat of liquids as well as of vapors. There are half a dozen volumes now before me. Opening at random, "Well's Principles of Chemistry", I read:

"Latent Heat—When a *solid* is converted into a *liquid*, or a liquid into a vapor or gas, heat in large quantities disappears and ceases for the time to affect the thermometer. It is not, however, absolutely lost, but remains incorporated with the substance of the *liquid*, or the gas, in an insensible condition. Heat thus disappearing is termed latent or insensible heat. When vapors are condensed into liquids, or *liquids* are changed into *solids*, the latent heat in them is set free and made sensible."

He gives examples of all these cases of the disappearing and reappearing of heat. All the others announce the same law. "Fowne's Elementary Chemistry" (a book every gas engineer ought to possess), says:

"During fusion bodies absorb a certain quantity of heat, which is not indicated by the thermometer; at a given temperature—the fusing point, for instance—a certain weight of substance contains, when solid, less heat than when liquid. The law is perfectly general. Whenever a solid becomes a liquid, a certain fixed and definite amount of heat disappears, or becomes latent; and conversely, whenever a liquid becomes a solid, heat to a corresponding extent is given out."

The latent heat of fusion is given of fourteen different articles, viz., water, mercury, phosphorus, lead, sulphur, iodine, bismuth, cadmium, tin, silver, zinc, calcium-chloride ($Ca\ Cl_2$, $6\ H_2\ O$), potassium-nitrate and sodium-nitrate.

According to the average of the authorities,

1 unit of C burned to CO_2 evolves 14,400 heat units.
1 " " C " " CO " 2,900 " "
1 " " C in CO burned to CO_2 " 10,100 " "

Here are marked differences which are worthy of being noted. What causes the difference? *Fowne* gives the following in explanation:

"In the formation of carbon dioxide, however, the second half of the oxygen appears to develop more than two-thirds of the total amount of heat; but this result is probably due, in part, at least, to the fact that when *carbon* is burned into carbon *monoxide*, a considerable but unknown quantity of heat is expended in converting the solid carbon into gas, and thus escapes measurement; while in carbon monoxide, the carbon already exists in the gaseous form, and therefore no portion of the heat evolved in the combustion of this substance is similarly expended in producing a *change of state*. It seems probable, also, that a similar explanation may be given of the inequalities in the quantities of heat produced by the combustion of different varieties of pure carbon and of sulphur—that is to say, that a portion of the heat generated by the combustion of diamond and graphite goes to assimilate their molecular condition to that of wood charcoal, and that there is an analogous expenditure of heat in the combustion of native sulphur"

Enough. I think, has been said on this subject. The quotations and instances given not only establish the fact of the existance of the latent heat of liquidity, but also the fact that, when a fuel has its constituent parts in different combinations or states, or is burned under different conditions, the heating power is different, and also the general law, that when an element or body is operated upon under different conditions, whether internal or external, the results will be different. This last principle deserves to be dwelt upon, on account of its importance in this connection. It is an established fact that the *specific heat* of a body is greater when it is in a liquid than when it is in a solid state. A substance is said in ordinary language to burn, when its elements unite with the oxygen of the air and produce new compounds. Chemically the oxygen is as much consumed as the other substance or substances. The combination is more or less active, and the heat produced more or less intense, according to the conditions under which the combination takes place. I quote from "Kane's Chemistry."

"There are but few bodies endowed with so great an affinity for oxygen as to enter into combustion at ordinary temperatures by contact with it. If they do combine at ordinary temperatures with oxygen, the products are not those which combustion would tend to generate, but a distinct class of substances, containing a smaller proportion of oxygen combined. Thus nitric oxide gas combines with oxygen, even when quite cold, forming red fumes of nitrous acid gas, which is an inferior degree of oxidation. Phosphorus, when burning at common temperatures, emits but little light, and forms phosphorus acid; if it be heated, it bursts into brilliant flame and forms phosphoric acid, which contains two-fifths more oxygen. Potassium combines at common temperature with oxygen, forming potash; but when heated it *burns with flame, and combines with three times as much oxygen.* [It would have been better to have said, *combines with three times as much oxygen and burns with flame*, the combination causing the more intense combustion.] In the complete combustion of organic matters the products are always water and carbonic acid. Thus, woody fibre, which is CHO, combines with O to form CO_2 and HO, but at common temperatures the slow oxidizement of woody fibre produces the black vegetable mould, a form of ulmine, the CHO taking O to from CHO_2. This slow combustion produces heat, although so much less than is evolved by the more rapid process that it may easily be overlooked. But if a number of sticks of phosphorus be laid together and allowed to oxidize, they will warm each other so much as to melt and burst into vivid flame. The energy of this slow combuation may be *much increased* by heat applied *below the point* which produces rapid action; thus tallow, when heated below redness, burns with a pale lambent flame, invisible in daylight, but still so marked that, if it be plunged into a vessel of oxygen, the whole mass bursts into brilliant combustion, forming then the ultimate products, water and carbonic acid."

The influence of spongy platinum in the evolution of heat is well known, when held over a mixture of air and inflammable vapor, or over the wick of a spirit lamp. Remove the platinum and the action ceases. Illustrations, however, may be quoted without number, such as, for instance, the action caused by the presence of a third body in catalysis.

Again, 1 lb. of C unites with $2\frac{2}{3}$ lbs. of O to make CO_2, and will heat 80 lbs. of water from 32° to 212°; and 1 lb. of H unites with 8 lbs. of O to form H_2O or water, and will heat 344 lbs. of water from 32° to 212°; hence, 1 lb. of O uniting with H heats, from 32° to 212°, 43 *lbs. of water*, and 1 lb. of O uniting with C heats, from 32° to 212°, 30 *lbs. of water*.

We see in the formulas, the reason of the difference in the heating effects. Just 3 times the weight of O unites with H during the combustion of H as there is of O uniting with C during its combustion. Hence a more intense chemical action and temperature in the one case than in the other. But the formula CO_2 gives us 3 volumes reduced to 2, and 2 *volumes* of O united with 1 *volume* of C; and the formula H_2O gives us 3 volumes reduced to 2, and 1 *volume* of O united with 2 *volumes* of H, or 2 *volumes* of O united with 4 volumes of H, *i. e.*, 4 times as large a volume of H unites with O as there is of C uniting with O, and hence the reason why 1 lb. of O combining with H heats 43 lbs. of water 180°, while 1 lb. of O uniting with C heats only 30 lbs. of water 180°.

There is another subject to which I wish to draw attention, the method by which the units of heat of different substances are ascertained, and in that connection to the effects of the nitrogen in the air and of pure oxygen. The determination of the heat of combustion of a given quantity of a combustible substance is a problem of the greatest practical importance, as from it is derived the economic value of every variety of fuel. The method is to burn the substance with the use of the smallest quantity of air that is sufficient for perfect combustion, in a vessel called a calorimeter, surrounded by water or mercury, the rise in the temperature of the water indicating the amount of heat evolved by the chemical action, corrections being made for the loss of heat by absorption, radiation, etc. If the substance were burned in pure oxygen, the result would not have a practical value, because combustion ordinarily takes place in air. Air being used in ascertaining the heat units, the loss of heat in raising the tempereture of the nitrogen of the air to that of the flame, as well as the heat necessary to burn the substances, is included in the final result, the units of heat. The values given are therefore of practical use.

I again quote from Kane, simply correcting his figures to make them correspond with later experiments:

"During combustion, the heat evolved is at first absorbed by the body which is then produced, but it is afterwards distributed through the mass of all neighboring bodies in proportion to their conducting powers. It is easy to calculate the temperature to which the product of combustion is in the first place raised. Thus 8 parts of oxygen unite with 1 part of hydrogen by weight to form 9 of water. If watery vapor had the same capacity for heat as water, the temperature of the vapor produced should be, since 1 part of oxygen heats 43 parts of water, 180°=eight ninths of $(43 \times 180)=6880$ above the freezing point; but the capacity of watery vapor in equal weight is only half that of water, and therefore it is more easily heated in that proportion; hence the temperature really produced is 6880×2, or 13760 above the freezing point of water. If, however, in place of pure oxygen, atmospheric air had been made use of, then 23 parts of oxygen are mixed therein with 77 parts of nitrogen, which must be heated to the same temperature with the watery vapor, and, of course, at its expense. The capacity of nitrogen gas for heat is .2438 or about half that of watery vapor, but in the air which is necessary to form 9 parts of water, there are 26.8, or almost exactly 3 times as much nitrogen, so that preisely six-tenths of the quantity of heat produced is absorbed by the nitrogen, and the temperature of the mixture rises only to 5504 above the freezing point. If the nitrogen had been present in a quantity 10 times as great, it would have absorbed 15-16 of the amount of heat evolved, and hence the resulting temperature should be only about 860°," which is below the point of combustion of the hydrogen.

It will now be perceived why in the former com-

munication, I calculated the heating power of the water in the tar as adding to the heating capacity of the tar; the oxygen in the water is of more value than if introduced with air, for the reason that it is not mixed with nitrogen, and it is burned precisely in the same manner as if it were introduced with nitrogen in air.

While on this subject I will make a quotation from Silliman, (First Principles of Philosophy), preferring to give the authorities rather than use my own language:

"A well regulated current of vapor conducted over the flame of bituminous coal by Dr. Fyfe, raised the evaporated effect preduced 37 per cent. above what was obtained from the unassisted coal. This increase is due to the decomposition of the steam by the hot fuel, and the consequent effect of the pure oxygen on the carbon."

This instance shows the value of water, when used in proper proportions with hot fuel, in adding to the calorific effect of it. I have before instanced the effect produced by dropping water upon burning tar, and might also have included the use of steam, and particularly superheated steam, with the tar. The uselessness of water as an extingnisher of fire, when it has gained a certain headway, was also referred to. I will now invite attention to the article in the "Journal" of the 16th ult., in reference to the "Danger of Lampblack." It says that a hand damp with perspiration, or a drop of water, will create the combustion which will start the lampblack aglow like charcoal. In lampblack factories, while great precaution is taken to prevent fires, a rainy or sharp frosty day will start a dampness upon the inside of a window pane, and the flying particles of dust lighting upon this creates a spark which, communicating with the pile, sends a glow of fire with wonderful rapidity through the galleries of the shop. Here we have an instance in illustration of the principle contended for, that water or dampness, so far from preventing or putting out a fire, actually causes it, and why? For two reasons, 1st, because the carbon in form of lampblack has a strong affinity for oxygen, but yet when dry does not attract the oxygen of the air, being in that condition mixed with nitrogen, so as to chemically combine with it; 2nd, when moistened, however, the oxygen of the water is brought into such intimate contact with it, that chemical action takes place, the oxygen unites with the carbon and produces heat enough to set it on fire, and the whole mass is soon in a state of combustion, which is intensified by the burning of the hydrogen set free from the water.

It is now apparent why the formula—$p=c+(H-\frac{1}{8}O)$ is a very defective one. It is the merest skeleton of a formula; it has the bones but lacks the flesh and blood. It makes no provision for the condition which the fuel may be in, whether solid, liquid, vaporous, or gaseous; nor whether it is dry or moist, nor in what percentage; nor whether oxygen is introduced with nitrogen in the air or whether it is a constituent of the fuel; it does not take into consideration the volumes of the constituents, nor the fact that when combustion takes place under different conditions, there is a greater or less intense chemical action and calorific power; in fine, it does not include in its terms, the varying conditions, internal and external, which the substance undergoing combustion is liable or may be subjected to. The flow of fluids through pipes is a much more simple problem, and yet the formula is much more comprehensive—

$$Q=1350d^2\sqrt{\frac{hd}{s(1+d)}}$$

includes in its terms the pressure or height of the fluid, the diameter of the pipe, the length of the pipe, the specific gravity of the fluid, the modulus or co-efficient of friction, the square root of some of the terms arising from the velocity of falling bodies of which gravity is an element; and the data are so arranged as to give direct and inverse proportions as the case requires. This formula is not a fully perfect one, but yet is constructed to embrace, in an eminent degree compared with the other, the variations to which the elements are liable.

Among other elements, when calculating the calorific units of different varieties of coal, the percentages of ash should be taken into account. For instance, if one kind of coal contains 5 per cent. of ash and another 25 per cent., it is evident that the effective heating powerof the latter will be less than that of the former, irrespective of other considerations, because a larger amount of inert or useless matter has to be heated. This should be a factor in the formula. It is now always omitted.

"V" further says—"it seems to me that the question is—are there any experimental or practical results on record, absolutely authenticated, that demonstrate that the actual heating power of tar and petroleum is larger than the calculated power?" I beg pardon for saying that I felt some degree of surprise on first reading this question. One would think that "V's" own statements produced by him in the paper read before the Society of Gas-Lighting, in proof that "in practice the comparison either by weight or volume is still more favorable to the tar" than the calculated power, would have answered the question before it was penned. In that article he calculates the calorific power of the tar and gives it as eqnal to 13,468 units of heat, or 22 7-10 per cent. higher than that of coke. He then quotes from Dr. Ure that coal tar is fully 100 per cent. more efficient as a fuel, weight for weight, than coke, *i. e.*, its heating power is twice that of coke. He then gives the result of *their own trial* of tar for over 120 days, it being that the tar is 150 per cent. more efficient, weight for weight than coke, *i. e.*, that its heating power was found to be more than 2½ times that of coke. He then gives another instance of a trial extending over 32 months, the result being that the tar was 120 per cent. more efficient than coke, *i. e.*, 1 lb. of tar was equal to 2·2 lbs. of coke; his calculated power being only 22 7-10 per cent. higher than that of coke. I will give another instance: In a gas works in which tar has been constantly and successfuly used for a longer period than the time last named by him, it has been found that 500 lbs. of tar is equal to 1260 lbs. of coke, or 2½ times as efficient. These facts ought to satisfy "V"; they must be satisfactory to those who accept them as facts, and in regard to the substantial accuracy of them as given there does not seem to be cause for doubt. The conclusion in a general way may be said to be that the heat of combustion of petroleum and tar is about twice that of coal and coke.

In the article on the "Eames System." quoted by "V," Prof. Wurtz says that H. Sainte-Claire Deville, experimenting for the French Government, found that the calorific power of one sample of Pennsylvania oil was 9,963 Centigrade units, which are equal to 17,933 Fahrenheit units, and that of another sample was 10,672 Cent. units, which are equal to 19,210 Fahr. units, or 40 per cent. greater than the total calorific power of charcoal, and 29·89 per cent. greater than "V's" theoretical power of tar, the heating power of tar being greater than that of oil. In some of the trials made in England to ascertain the practical heating power of oil, it was found to exceed its full theoretical power. "V's" question seems to be fully answered by his own testimony, as well as that of others.

Prof. Wurtz deducts in his calculations some of the elements after the usual method, thus reducing the theoretical heating power of the oil, but he takes into consideration other and new matter, for instance, the fact of the oil being fused carbon, the densities of the vapors, etc. If the oil were perfectly consumed, it would no doubt be found that the actual heating power is fully equal to that stated, and would exceed the theoretical power estimated by the usual rules; but if all the elements were introduced into the calculation which properly belongs to it, the theoretical heating power would be found to correspond to the experimental power.

There is no formula, or at least none known to me, that will cover all the forms under which the different fuels may appear in regard to their composition, and the different conditions under which they may be consumed. As all questions, however, in the single rule of three and compound proportion may be solved by analysis, so all questions relative to the units of heat of any substances may be worked out by means of a similar method of analysis. I give the following illustration to close this article with:

How much oil and coal is reqnired to heat 10 lbs. of water sufficiently to decompose and consume it, and what is the resulting temperature; what will be the saving effected and how much water is required to extinguish the fire?

1 lb. of hydrogen will raise the temperature of 62,012 lbs. of water 1°.

1 lb. of solid carbon will raise the temperature of 14,400 lbs. of water 1°.

1 lb. of oil will raise the temperature of 18,000 lbs. of water 1°.

1 lb. of solid carbon will raise the temperature of 4·8 lbs. of water 3,000°.

1 lb. ot oil will raise the temperature of 10 lbs. of water 1800°.

Steam will decompose in the presence of liqnid carbon at a temperature of 800°, to which add 1000° for the latent heat of steam, and we have the 1800°, which is more than sufficient, the specific heat of steam being only 17-20 of that of water.

10 lbs. of water contains 8·89 lbs. of oxygen and 1.11 lbs. of hydrogen.

8·89 lbs. of oxygen combines with 3.33 lbs. of carbon to form CO_2.

8 89 lbs. of oxygen is mixed with 29·76 lbs. of nitrogen in the air.

In oil there are about ·72 ibs. of hydrogen to 3.33 + 1=4.33 lbs. of carbon.

1 lb of hydrogen heats 141·35 lbs of nitrogen 1800°,
·21 " " " 26·76 " " 1800°,
which is equal to 13,026 heat units, and is a *gain*—
3.31 lbs. of C × 14,400..... = 47,664 heat units
1·11 + 21 + .72 = 2.04 lbs. of H ×
62,012..... = 124,273 "
Total..... 171,937 "

which is obtained by the use of 4·33 lbs. of carbon.

4.33 lbs. of carbon is contained in 5·15 lbs. of oil = .77 gallons.

5.15 lbs. of oil × 18,000 (when burned alone) = 92,700 heat units.

By the use of .77 gallons of oil, 10 lbs of steam is heated and decomposed, with a gain of 79,237 heat units or 85½ per cent, nearly double. This makes .77 gallons of oil equal in efficiency to 1.43 gallons without the use of water, or 1 gallon equal to 1.85 gallons. The consumption of 1 lb. of carbon is sufficient to bring into play the chemical agents in 10 lbs. of water.

10 lbs. of steam = 198.64 cubic feet of steam (its density being 9) which is composed of 198.64 cu. ft. H and 99.32 cubic feet O. 99.32 cubic feet of O combines with 49.66 cubic feet of C to form CO_2.

These figures show the the cause of the increase of heating power by the proper use of water, and if to the heating effect of the 198.64 cubic feet of H and the 49.66 cubic feet of C is added that of the H contained in the oil and the saving of heat by the non-admixture of the oxygen in the water with nitrogen, we shall arrive at the same result as that deduced above.

It is difficult to conceive of water acting as fuel, as we naturally judge respecting it by the everyday use it is put to of extinguishing fire; yet it is true that when added in proper proportions to an active fire, it is not only adding "fuel to the fire," but a fuel which increases its intensity and efficiency.

When coal is used for fuel instead of oil, it will require about 2½ lbs. of carbon to heat 10 lbs. of water and enable the oxygen set free to unite with another portion of carbon to form CO_2; requiring in all some 6 or 7 lbs. of fuel. Therefore, the consumption of 6 or 7 lbs. of solid fuel will heat and bring into action the chemical agents contained in 10 lbs of water. I a greater weight of water is used it will act injuriously by cooling the fire.

In general terms it may be said that to 1 lb. of coal may be added 1 pint of water, and to ¾ pint of oil may e added 1 point of water, the water being suppliep

gradually as the consumption of the fuel takes place. If in a bench of 6's, 2000 lbs. of coke is required per day to heat it, 250 gallons or 33⅓ cubic feet of water may be used with it, which will reduce the quantity of coke to 1078 lbs.; a saving of 922 lbs., or about ¾ of a chaldron. Or if 190 gallons of oil, by itself, is needed to heat a bench of 6's, then by the use of 250 gallons or 33⅓ cubic feet of water, the quantity of oil required would be reduced to 102 gallons; a saving of 88 gallons.

How much water will it take to extinguish a fire in which 10 lbs. of coal is being consumed, *i. e.*, in which 10 lbs. of coal is in actual and active combination with the oxygen of the air? It will be remembered that more than 10 lbs. of coal will be n use, if it is lumpy, because the consumption is principally at and near the surface, but with this extra weight we have nothing to do; the 10 lbs. in an active state of combustion alone enters into the calculation. The estimate may be based upon four suppositions:

A. The fire may be of the temperature of a common fire, viz:, 1150°; to reduce which to 500°, would cause a loss of 650°.

B. It may be in a state of more intense combustion, say 2500°, which would require a deduction of 2000° in its temperature.

C. The water may be supplied in such a quantity as not quite to attain the boiling point; it would then have an addition of 150°, say from 60° to 210°.

D. The water may be allowed to boil in order get the benefit of the latent heat of the steam; the fire would then be deprived of about 1140° of heat, say 150° to boil the water and 990° for the latent heat of the steam.

The specific heat of hard coal is .2800; that of the steam need not be noticed, since it escapes as fast as formed. The following formula is easily constructed

$$W = \frac{stw}{T},$$

in which *W* equals weight of the water, *w* equals weight of the coal in a state of active combination with the oxygen of the air, *T* equals temperatnre gained by the water, *t* equals temperature lost by the coal, *s* equals specific heat of the coal.

1st. Assume A & C to be the conditions; then—

$$\frac{.28 \times 650 \times 10}{150} = 12{\cdot}13 \text{ lbs. water to extinguish the fire.}$$

2d. Take A & D; then—

$$\frac{.28 \times 650 \times 10}{40} = 1.6 \text{ lbs. water.}$$

3d. Take B & C; then—

$$\frac{.28 \times 2000 \times 10}{150} = 37.33 \text{ lbs. of water.}$$

4th. Take B & D; then—

$$\frac{.28 \times 2000 \times 10}{1140} = 4{\cdot}91 \text{ lbs. of water.}$$

The specific heat of wood being about double that of hard coal, if it were the material undergoing combustion, about twice the quantity of water would be required to extinguish it.

The subject is not nearly exhausted. but if I have succeeded in making myself understood, perhaps some suggestions may have been made, which may be of some practical use.

The principal might be illustrated in various other ways; the instance given above have been taken, having a reference to the subject under consideration.

J.

Gas Stove Accidents.

ALBANY, N. Y., Feb. 16th, 1877.

Mr. Editor: It is very evident that the object of the articles in your issue of the 2nd inst. under the above heading, and upon "The Combustion of Coal Gas to Produce Heat" &c., was to advocate such use; but, if the assertions made in those articles are true, it is equally evident, I think, that gas cannot be safely used as fuel except under impracticable conditions. I will explain.

It is assumed in those papers that the only methods used for burning gas as fuel are either, burning it through small holes in a gas pipe (the English way), or by some of the various modifications of the Bunsen burner.

Now s all of these methods burn the gas with a blue flame it follows—as is also admitted in the said paper—that he combustion is not only imperfect, and therefore wasteful, but that the unconsumed gas is carbonic oxide, a virulent but oderless poison; and it follows further that, although the advice given to use these gas stoves only in open rooms, *if adopted*, will certainly lessen the danger, it is evident it cannot remove it entirely, even in such rooms, and does not apply at all where the rooms are small and close.

But how many people will be goverened by your advice not to use a gas stove without opening doors or windows? When you remember how careless our countrymen are in all matters relating to health, I think you will hardly expect this one to be an exception; and that the necessity is urgent, Dr. Greene's experiment with the pigeons (quoted in your paper) is conclusive. If after a gas stove is used in a close room one hour, a pigeon then introduced into the room will die in 20 minutes, the air must be deadly. That so few deaths have occured from using gas stoves is no answer to this experiment, as there is always *some* ventilation where they are used, so that life is safe. But with a deadly poison always passing into the air, some of it must be breathed even when the ventilation is good, and hence the depression of spirits and severe headache, so often suffered by persons using gas stoves in close rooms.

If, then, there is another way of burning gas as fuel than those referred to by you, it appears to me it should not be so used at all, except under very favorable conditions. But fortunately your premises are not true. There is another way evidently not known to either you or Mr. Watson, but which is worthy of your notice, if there is any virtue in tests, made by such competent men as Isaac Battin, Esq., the superintendent of the Albany Gas-Light Company. According to these experts this new way removes entirely the objections above stated to the use of gas as fuel, because it makes a nearly perfect combustion by burning up the carbonic oxide instead of merely liberating it, evidenced by the fact that the gas is burnt without flame from passing through red hot iron.

But, that you may judge for yourself how far these assertions are justified by facts, I send you the following description of the gas stove in question;

It consists of a close cast-iron cylinder with wire gauze diaphragms at its center, and is so arranged that the air and gas used are not only mixed in proper proportions *before* being burnt, but are also so intensely heated *before* and *while* being burnt, that the gauze cannot be cooled down below a bright red heat, whereby all the gas passing through it must be consumed, including the carbonic oxide formed, as otherwise there would be flame, which there is not—flame always indicating imperfect combustion and consequent waste of heat.

Now, burning gas mixed with air through wire gauze is an old method long since abandoned, because of the objections attending its use. As the apparatus used for it was constructed, the result could not be satisfactory, as it was arranged to permit, (instead of prevent) currents of cold air to sweep the surface of the gauze, and force the flame to take a conical shape, whereby the outer edge of the gauze was exposed, and the whole of it kept cool. It will be observed that the opposite of this construction is the object of the improved method above described, and that therein consists its novelty and value. In proof of its successful operation, I send you a copy of the certificate given by Mr. Battin of the tests made by him above referred to.

Yours truly,

H.

The Retort Courteous.

Mr. Editor: Such, for instance, is Mr. Cathels reply to my note of inquiry in the Journal of the 2d of February. I am unable to determine, by a reference to said inquiry, just what could have provoked such a vindictive and savage reply, unless it was my lapse into facetiousness at the close.

A country manager applies to a professional luminary for light, and instead of receiving light he encounters wrathful lightnings. I asked the favor of an illustration in practical working of a proposition advanced by Mr. Cathels at the late meeting of the American Association. I was sure I misapprehended his meaning, or that my deductions were wrong. I am sorry that traps and bait were scented because none were set.

Mr. Cathels suggestion. at the close of his article, of three or four parallel streets at successive elevations of fifty feet does not clear my mind, as doubtless it should. It Mr. Cathels would be forbearing enough to indicate on which of these streets the works should be located, and the manner and extent of advantage gained in distribution by moving from the lower, he would not only favor me, but possibly others, to whom I have in vain applied for a solution of my difficulty.

E. S. STULTUS.

Gas Stove Accidents.

PORTLAND, ME., February 15, 1877.

Mr. Editor: An article in your paper of the 2nd inst. says that the death by suffocation from using gas stoves, are owing to want of care in regulating the flame and providing for ventilation.

In my opinion no stove is safe that has no funnel or flue to carry off the products of combustion. I have used the Cambridge Gas Stove this winter for warming my bath room. The ventilation is through a three-inch funnel, and the air is as pure as with the best coal or wood stove. Yours respectfully,

E. H. DAVIES,
Pres't Portland Gas-Light Co., Me.

Notes on the Masonry of the East River Bridge.

[A Paper by Francis Collingwood, C. E., Member of the Society. Presented November 1st, 1876.

Having spent considerable time during the past winter in getting together the details of the masonry and attachments of the East River bridge, so far as completed, and in revising the estimates of the work so far as practicable, the writer desires to place on record the following details respecting the two towers and anchorages.

The figures referring to the towers will be given chiefly in connection with the Brooklyn tower and important differences only will be noted. The principal dimensions of these structures are as follows:

1st. HEIGHTS.

BROOKLYN TOWER:	
Bottom of foundation below mean high tide	44 feet 6 in
Base of stone masonry	20 " 0 "
Depth of water in immediate front of tower	12 to 16 " 0 "
Height of roadway above mean high tide	119 " 3 "
Height of springing of arches above high tide	198 " 0 "
Height of springing of arches above roadway	79 " 3 "
Height of ridge of roof stone above mean high tide	271 " 6 "
Height of ridge of roof stone above bottom of foundation	316 " 0 "
NEW YORK TOWER:	
Bottom of foundation below mean high tide	78 " 0 "
Base of stone masonry below mean high tide	46 " 6 "
Depth of water at immediate front of tower	34 " 0 "
Bottom of foundation to ridge of roof	349 " 6 "

In addition to all, there will be a balustrade around the towers on the cornice at the roadway and also at the edge of the roof slopes. This will increase the height to 276 feet above tide.

2d. AREAS, OR HORIZANTAL SECTIONS.

At bottom of foundation (*i. e.* bottom edge of caisson):
Brooklyn tower is..... 102×168 feet = 17 136 sq. ft.
New York " ..... 102×172 " = 17 544 "
At top of timber, the extreme measurements of the base of the masonry are: for
Brooklyn tower, 151×49 ft.
with a solid section..... = 8 542 sq. ft

New York tower, 77 × 157 ft., with a solid section..... = 9,115 sq. ft.

At high water surface the extreme measurements are:

Brooklyn tower, 57 × 141 ft. with a solid section..... = 5,172 sq. ft.

New York tower, 59 × 141 ft. with a solid section..... = 5,968 sq. ft.

First 10 feet above high water of Brooklyn tower, 56 × 140 feet, with a solid section.... = 4,983 sq. ft.

New York tower, 59 × 140 feet, with a solid section... = 5,172 sq. ft.

Brooklyn tower, about 39 ft. between 1st and 2d sloping offsets..... 53½ × 137½ " = 4,605 sq. ft.

Brooklyn tower, about 38 ft. of same between 2d offset and cornice..... 51 × 135 " = 4,100 sq. ft.

Brooklyn tower, upper member of cornice at roadway .... " = 4,932 sq. ft.

At the base of the three shafts above the roadway, extreme measurements of Brooklyn tower, 45 × 131 feet solid section of same (united)..... = 2,297 sq. ft.

At the springing of the arches, extreme measurements of same, 42½ × 128½, solid section (united)..... = 1,952 sq. ft.

At base of upper cornice, extreme measurements of same, 40 × 126 ft. with solid section..... = 2,940 sq. ft.

Top members of upper cornice, extreme measurements, 49 feet 10½ in. × 135 feet 10½ inches. with a solid section..... = 4,343 sq. ft.

Above high water, the New York tower differs from the other only by an increase of three feet of thickness in the direction of the axis ef the bridge.

3rd. Quantities of Masonry.

Brooklyn Tower:

From base of masonry to 2 ft. 4 in. above tide.....	6,144	cub. yds.
From 2 feet 4 inches above tide to roadway.....	19,250	" "
From roadway to springing.....	6,033	" "
From springing to top of tower.....	6,787	" "
Total stone work, excluding balustrades.....	38,214	" "
Concrete in well holes, caisson chambers, on top of timbers, and between timbers.....	5,669	" "
Timber and iron in Brooklyn caison	5,253	" "
Total cubical contents.....	40,136	" "

New York Tower:

From base of masonry, to 3 ft. 7 in. above tide.....	13,383	" "
From thence to roadway.....	19,820	" "
From roadway to springing.....	6,329	" "
From springing to top of tower.....	7,413	" "
Total masonry, excluding balustrade.	46,945	" "

The timber and concrete in the New York tower are about one-third more in quantity than in the Brooklyn tower. The amount has not (September 1st, 1876) been made up.

4th. Weights.—Taking, per cubic foot, the granite masonry at 153 pounds, the concrete at 120 pounds, and the timber with contained iron and concrete, at 70 pounds, we get:

Brooklyn Tower:

Total weight of stone masonry.....	78,931	net tons.
" " concrete.....	9,184	"
" " timber, Sep. 1, etc.	4,964	"
Total.....	93,079	"

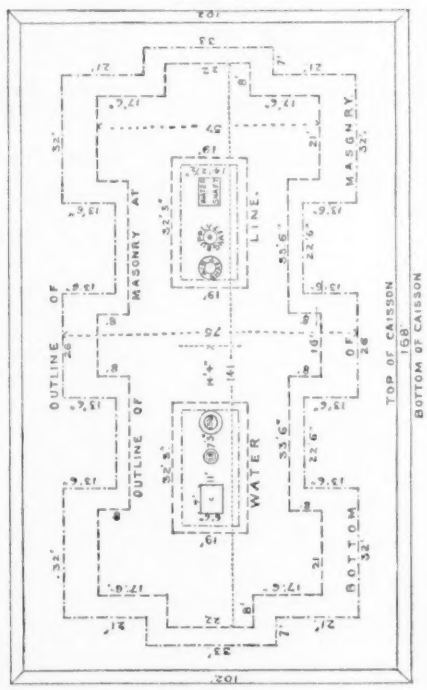
5th Pressures.—From the foregoing we get, for the Brooklyn tower:

Pressure at bottom of foundation, about.....	15½	tons per sq. foot.
Pressure at base of masonry, per square foot of bed, about.....	9¼	" "
Pressure at high tide, per square foot of bed.....	13	" "
Pressure at base of central shaft above roadway, final (pressure) about	26	" "

The latter is the greatest pressure at any point in the tower masonry, being about 361 pounds per square inch, and it includes the pressure resulting from the two central cables. At the bottom of the foundation of the New York tower, the pressure is about 6¾ tons per square foot of area, and at the base of the masonry, about 10½ tons per square foot of bed. The pressures at the bases of the masonry will be increased about 8 per cent. by the weight of the superstructure and load.

6th. Description of Tower Masonry.—The general form of the tower masonry is shown in plan by the following. (Fig. 1.) It consists of three buttressed

FIG. 1.



shafts, joined together so far as the roadway, by four connecting walls. At the course next the timber in the Brooklyn tower, these walls are 17 feet thick; the thickness diminishes by offsets, until at high water and above, it is 10½ feet only.

Below high-water the two well holes thus formed are filled with concrete, and from high-water to the roadway they are left open. Water, in considerable quantities* collected in them during construction.

Similar well holes or spaces were left from two feet above the arches to within 4½ feet of the top of the tower, but each of them is divided by an interior connecting wall (parallel to the othsrs), thus making four spaces of 4 by 33 feet section and 25 feet high.

The only other space in the masonry is a small vertical opening in one of the side shafts, 2 feet 5 inches by 3 feet, starting just above the springing of the arch and connecting with one of the well holes above. By means of an iron ladder in these openings, and a trap through the roof courses, permanent access can be had to the roof.

Each arch has a span of 33 feet 9 inches. The arches are pointed and formed by the intersection of two arcs or circles described from centers in the springing plane, with radii of 45 feet 9¼ inches. The extrados has a radius of 48 feet 2 inches, with centers in the springing plane, so placed as to give a thickness of arch of 5 feet at the springing and of 4 feet at the point. The points of the arches are 114 feet 4 inches above the roadway.

The changes which have been noted in the dimensions of the horizontal sections are made by sloping offset in the buttresses, each of 7 feet 6 inches rise. Two of these are below and two above the roadway, and they connect the several vertical sections mentioned.†

Leaving the subject of dimensions, the next thing in order is the character of the masonry. Throughout the work the specifications for stone have required, among other conditions, that the beds of all stones should be rough axed (or pointed), so as to allow of one-half inch bed joints, with no pitch holes of more than nine inches diameter, or one and a half inches depth; and that the stone should be cut true to the rise. All vertical face joints from four feet below tide, are one half inch; below this, only good quarry faces were required; this gave joints of four to twelve inches, and closer ones could be secured for the face, by selecting the stone. In dimension backing, the vertical joints were to be from one to three inches in width, and in all common backing, quarry faces were allowed.

Except where a face stone abutted against dimension backing, the rear face was left rough. Headers were allowed to be wider at the rear than the face, provided they were jointed back sufficiently for the adjacent stretchers. All face stone were paid for, according to the dimensions of the plan, deficiences on each stone being charged for at contract price, and excess allowed for as backing. The rule was finally adopted and is now a part of every specification, that all stones of irregular shape (such as arch stones, cornice stones, etc.) sh ll be paid for, according to strict net measurement of their cubical contents; no constructive measurement being allowed. All bidders were notified to make their bids on this basis. The rises of the courses have been fixed in every case—the contractor bidding on specific rises. To accommodate the quarries, however, this has been varied between the limits of 20 and 30 inches; few being less than 27 inches, and the greater number being of 24 inches rise. The lengths of stretchers were fixed at from six to 15 feet, according to position, and the widths a from three to five feet. For ordinary stretchers, the contractor was allowed to vary in width, within moderate limits, where it did not affect stability or plan.

Headers were made from three to six feet in width, the most common being from three to four feet, and none were allowed less than six feet long. The face stones ranged in cubical contents from one and a half to five cubic yards each (the face key-stones measuring five and a half yards each). The backing will average one and a quarter cubic yards per piece in limestone, and one and a half cubic yards in granite.

All but the cornice and offset stones from high water to the roadway, have a rock face of about four inches projection, and the arrises are pitched to a line. The corners of the buttresses have a vertical chisel draft of one and a half inches width. The arrises of all the offset stones have the same draft, and the face between is pointed down to a half-inch projection. To heighten the contrast and produce the effect of horizontal bands, the granite in the offsets is of much lighter color than the rest of the stone. The faces of all the cornice stones are of six cut work (except on the sloping offsets as before described). Above the roadway, the face stones of the buttresses have the rock face projection reduced to about three inches; and a chisel draft is carried around the face of every stone. The pilasters facing the roadways are finished like the offset stones; and the intrados of the arches are smooth-pointed. The outer arch stones have a draft three inches wide, cut on the curved edge of the face and two inches wide an the other face edges: thus making a raised panel of one and a half inches height, which is rough pointed between the drafts.

The vousoirs have a uniform thickness (length of curve on intrados) of two feet three inches. This gives a constantly diminishing thickness of the spandrel courses. The buttress and spandrel courses were, however, made to correspond in rise to the top of the thirteenth arch course (this having a rise on the spandrel of 23¾ inches). The eighteenth spandrel course had a rise of only 18¼ inches, and from the thirteenth to the eighteenth, the spandrel and buttress courses were unconformable. The bond was obtained by cutting down each and interlocking at the intersections, as best served to secure strong work. The study for this purpose was done by means of a model. The reason for not using thinner buttress courses and thus avoiding the necessity for such a construction, was, that the courses were too thin for the sizes of stone tequired by the regular bond in the buttresses.

The general rule of the bond througbout the work, is two stretchers to one header.

[To be continued.]

* This was the means of saving the life of a workman, who fell a clear descent of 105 feet. He struck upon an empty barrel floating in the water, crushed it and escaped with no injury beyond a few bruises.

† Through each of the spaces spanned by the arches there will be erected one track for cars propelled by steam, and two tracks for vehicles drawn by horses. In addition, there will be a foot track, which will be central in position and abut against the central shaft, passing around it both ways by tracks raised high enough to clear the cars,; these tracks will be reached by flights of steps on each side of the shaft. This makes in all seven tracks on the roadway—four for horses, two for street cars, and one for foot way.

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FRIDAY, MARCH 2, 1877.

Gas-Light Intelligence.

United States.

PUBLIC LAMPS IN YONKERS.

The Westchester Gas-Light Company has offered to light the street lamps of Yonkers for $25 per year each. The price now paid is $35.33.—*N. Y. Telegram.*

FRANKLYN GAS LIGHT CO., PA.

Mr. E. A. Keene, formerly Superintendent at Washington and late of the Paterson (N. J.) Gas Co., is at present Superintendent of the Franklin Gas-Light Co., Pa.

TAPPING GAS.—An Indianapolis (Indiana) saloon keeper has been detected in tapping the mains of the gas works and stealing gas—for which he is to pay $50, serve one year in the penitentiary, and be disfranchised for a year after his term expires. "Honesty," etc.—*N. Y. Telegram.*

COLUMBIA GAS-LIGHT CO., GA.

Mr. Oliver McIlhenny, recently engineer of the Montgomery (Ala.) Gas Light Company, has taken charge of the Columbia (Ga.) Gas Works, and is succeeded at Montgomery by Mr. J. T. Jones as engineer, and the works there are being remodeled for coal; light wood having been previously used.

SELMA GAS CO.—The following gentlemen have been elected officers of the Selma (Ala.) Gas Co. for the ensuing year:

President and Treasurer—J. R. Kenan.
Engineer and Superintendent—H. Harthau.
Collector—A. H. Lloyd.

PROVIDENCE, R. I., GAS COMPANY.—At a meeting of the directors of this company held in Providence n Feb. 14th, the Hon. Amos C. Barstow was unanimously elected President of the company, in place of Amos D. Smith, deceased.

NEW ENGLAND ASSOCIATION of GAS ENGINEERS.—At the annual meeting of the New England Association of Gas Engineers, held in Boston on the 21st ultimo, the foll owing officers were elected for the ensuing year:

President—Samuel G. Stiness, of Pawtucket, R. I.
Vice-Presidents—F. C. Sherman, of New Haven, Conn.; L. P. Gerould, Newton, Mass.
Directors—J. M. Hill, Concord, N. H.: J. H. Armington, Brooklyn, L. I.: W. A. Stedman, Newport, R. I.; C. D. Lamson, Boston, Mass.; W. C. Perry, Bangor, Maine.
Secretary and Treasurer—Geo. B. Neal, Boston.

British West Indies.

NEW GAS WORKS.—We learn that gas works have been erected in the city of Kingston, Jamaica, British West Indies, and the city will be illuminated this present month.

GAS EXPLOSION ON SHIPBOARD.—The *Liverpool Mercury* reports that early in the morning of Wednesday, Nov. 29, an explosion of a very alarming character, resulting in injury to a number of lumpers and other laborers, occurred on board the Allan steamer *Prussian*, lying in the Wellington Dock, and under orders to sail on Thursday from the Mersey for Portland, Maine. The vessel was loading with a general cargo, and for the purposes of ballast nearly 200 tons of coal had been placed in the lower main hold. This coal had been put on board in a somewhat damp condition, but not the slightest idea appears to have been entertained that it would generate gas which might lead to an explosion. The coalheavers finished on the previous Saturday night, and having swept up the deck they placed the coverings over it, intending to proceed with the st owing of sugar and other cargo on the orlop deck. At the time mentioned on Wednesday, a number of lumpers or cargo men went below for the purpose of proceeding with the work, several of them having lamps in their hands. The moment the first man reached the orlop deck a frightful explosion took place, which blew off the covering of the main lower hold, and sent up a volume of flame many feet above the main deck. All the men who were below, or were in the act of going down, were more or less injured, most of them falling from the ladders which they were descending into the hold.—*Ibid.*

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,
24 PINE STREET, NEW YORK CITY.

MARCH 2, 1877.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	Par.	Bid.	Asked.
Harlem	$1,850,000	50	105	110
Manhattan	4,000,000	50	220	225
Metropolitan	2,500,000	100	145	150
" Scrip	$1,000,000	...	100	103
" Bonds	500,000	1000	100	103
Mutual	5,000,000	100	103	105
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	130	131

Gas Co.'s of Brooklyn.

Brooklyn	2,000,000	25	175	180
Citizens	1,200,000	20	100	102
" Scrip	320,000	1000	95	97½
Peoples	1,000,000	10	50	55
" Bonds	$ 325,000	...	---	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	76	80
Nassau	1,000,000	25	80	85
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	135	140
" Scrip		...	98	100

Out of Town Gas Companies.

Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	--	90
Baltimore, Md	2,000,000	100	150	170
" Ctfs., gold	1,000,000		105	—
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	98	100
" " Bds.	124,000	—	—	--
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	---
Fort Wayne, Ind		100	...	--
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	152	—
Hempstead, L	25,000	100	...	—
Jersey City	386,000	20	160	—
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	--	...
Bonds	30,000		90	
Laclede, St Louis Mo	1,200,000	100	100	110
Peoples, Jersey City		...	120	125
Leoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	--	--
Peoples of Baltimore		25	99	100
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	97	100
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	—	100
Stillwater, Minn	50,000	50	—	26
Suburban, W'stch'str	390,000	50	---	100
Saugerties, N. Y	15,000	100	110	115
Troy, Citizens	600,000	100	—	100
Central, Westchester	466,000	50	90	95

JAS. H. WALKER, SEN.
LATE ENGINEER AND SUP'T
MILWAUKEE GAS-LIGHT CO.

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CONTRACTORS FOR THE ERECTION & WORKING OF GAS WORKS.
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E H. BROADHEAD, Pres't First National Bank.
JOHN JOHNSTON, Marine and Fire Ins. Bank.
ALEX. McMILLAN, Pres't La Crosse Gas Co.
C. W. LOBDELL, Pres't Moline, Ill., Gas Co.
J. J. RANDALL, Winona, Minn., Gas Co.
JAMES RUSSELL, Superintendent Winona, Minn., Gas Co.

To Gas Companies.

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GAS SUPERINTENDENT,
425—2t Office of this Journal.

GAS-HOLDER FOR SALE.

CAPACITY ABOUT 40,000 CUBIC FEET, 50 FEET DIAMETER and 20 feet deep, all in perfect order, except the outside sheeting. It is substantial and of neat appearance; will be sold at a low price.

ALSO

A STATION METER

of about 70,000 cubic feet daily capacity, with entirely new dial and wheel work, and otherwiss in perfect order—by one of the best makers.

Apply to GAS-LIGHT CO., New Brunswick, N. J. 424-tf

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Single Lift GAS-HOLDER.

CAPACITY 10,000 CUBIC FEET.

Apply to THE PRINCETON GAS-LIGHT CO.,
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Gas Companies having Meters that be repaired will please inform us. The best references given from different Gas Companies and State Inspectors Address for terms, office 513 Fourtenth St., Washington, D. C. 411-3m1

FOR SALE---CHEAP.

HAVING BUILT A NEW WORKS, WE HAVE FOR sale, in lots to suit,

4 Sets of Purifying Boxes, each 9 x 16 ft. with Trays, etc., complete. Each set has a ten-inch Dry Center Seal, Valves, and Pipes, all in good order.

Hydraulic Mains, Dip, Bridge, and **Stand Pipes, Mouth Pieces, with Doors and Cotter Bars complete for 186 D Retorts, 14" x 22" and 12" x 20". Set in Threes.**

4 Vertical Air Condensers. 10 inch Connections.

Four Spray Washers.

Two Sets of the Purifiers and Condensers can be delivered immediately. Apply to PITTSBURGH GAS COMPANY, Pittsburgh, Pa. 422—4t

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HEAVY AND LIGHT CASTINGS OF ALL KINDS.

DAILY CAPACITY 125 TONS.

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TWO HOLDERS—one with Iron Columns and Girders.

HYDRAULIC (4 inch) STAND PIPES, MOUTH PIECES and Covers for two benches of Threes.

Three IRON RETORTS—Condensers, Washer and Washer Tank.

Three Round (4 feet) PURIFIERS and Covers, with Center Seal and connections Station Meter and several Dry Meters Apply at the office of this Journal. 412

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SHOVELS AND SCOOPS A SPECIALTY

For Gas-Light Companies.

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MADE FROM BEST MALLEABLE IRON AND STEEL.

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N. B.—Pipe from 3 inch and upwards, cast in 12-ft. lengths.
☞ SEND FOR CIRCULAR AND PRICE LIST.

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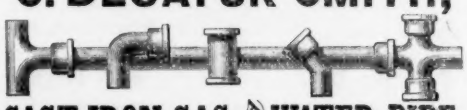

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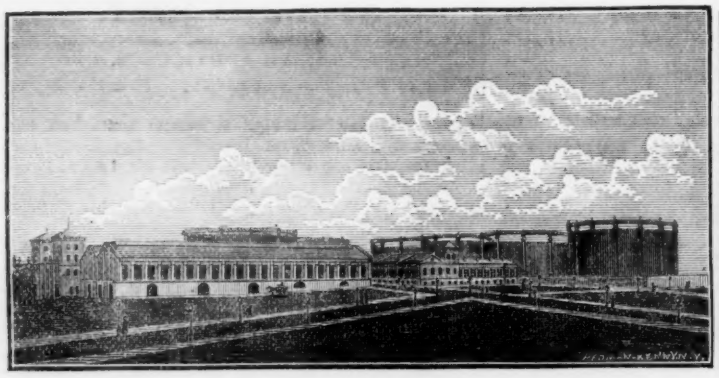
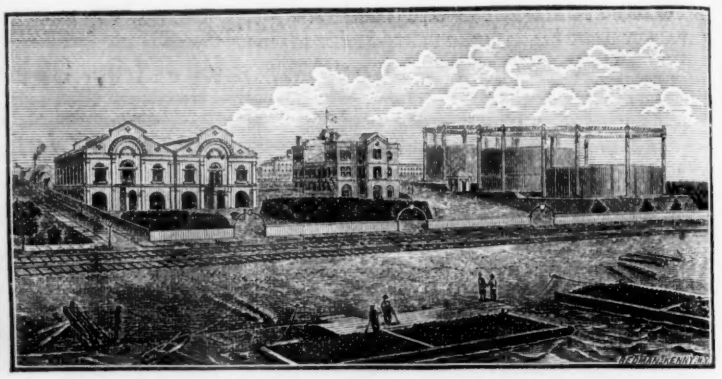


CINCINNATI GAS WORKS. ERECTED 1871-72-73.—WM. FARMER, ENG.



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An examination of the merits of these inventions as demonstrated by practical experience in a large number of Gas Works employing them, will not fail to convince the intelligent Gas Manufacturer of the great advantages derived from their use.

Gas of unexceptional quality, of high illuminating power is made at many of these works by these processes, at a cost of from 40 per cent. to 60 per cent. less than an ordinary quality of illuminating gas can be made by any other methods in use. Gas Companies generally may easily, and at small outlay for making the necessary changes in manufacturing apparatus, double their net earnings, and supply a much better light to their patrons, at greatly reduced prices.

The Company respectfully refer to Companies using these processes in this city, Reading, Penn., Chicago and elsewhere, and especially to the Mutual Gas-Light Company of Detroit Mich., whose works more nearly conform in all details of construction to the original plans of the inventors, than those of other Companies.

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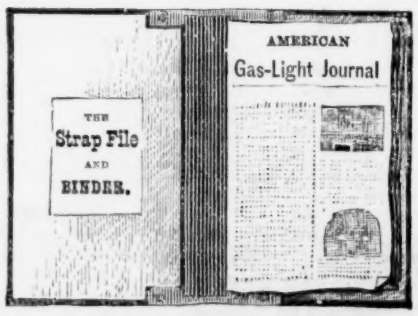

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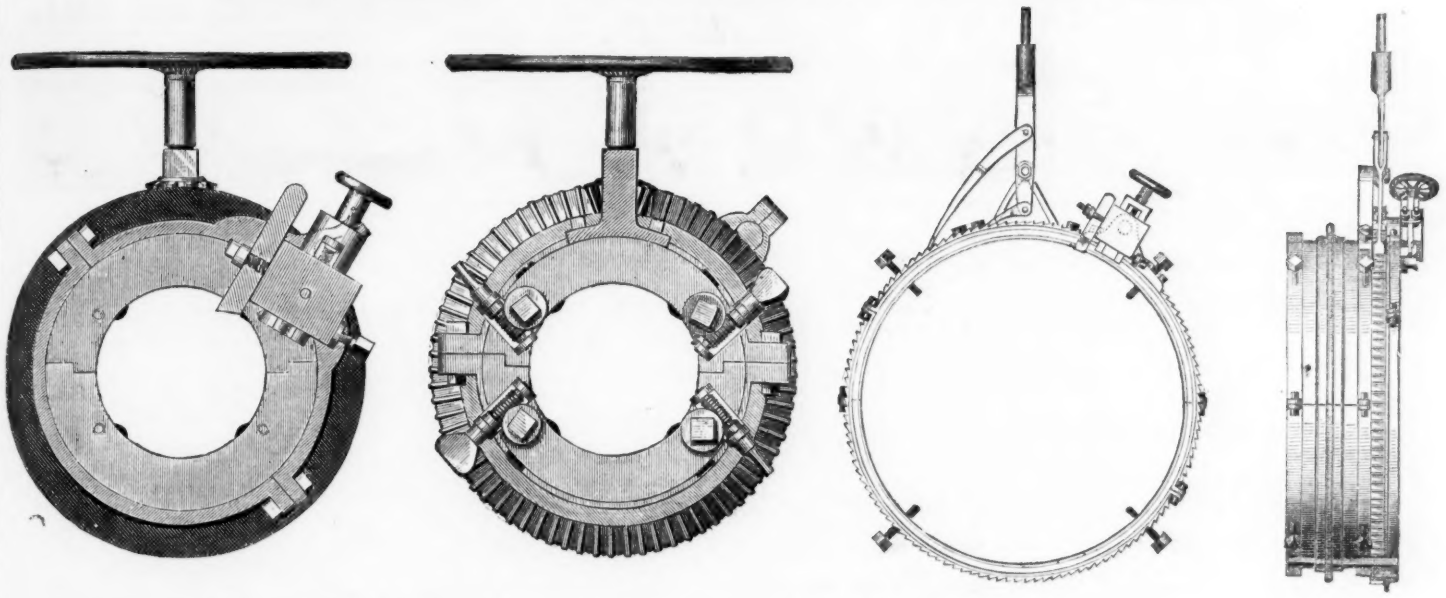
CAST IRON PIPE.



It will cut Cast or Wrought Iron Pipe, Shafts, or Columns of any size, making a clean, smooth, and square cut.

A Continuous Line of Pipe in a Trench or Building

cut, as well as Loose Pipe.
Our Machines for cutting 30-INCH PIPE have been furnished to the Manhattan and New York Gas Light Companies, and operate to their entire satisfactio
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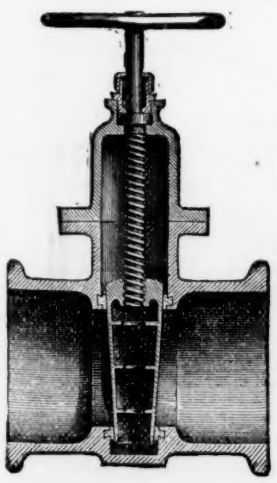

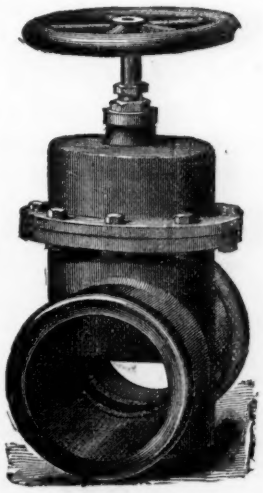

These Valves have been in use for several years, and are pronounced by all who have used them to be

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There is no LIABILITY OF COHESION between the Gate and Seat, and the Valves can be relied upon to SHUT TIGHT and OPEN EASILY at all times—an important desideratum when used for street mains, in cases of fire.

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NEWTON & WATERTOWN GAS-LIGHT CO., WATERTOWN, MASS.
LAWRENCE GAS-LIGHT COMPANY, LAWRENCE, MASS.
PEOPLES GAS-LIGHT COMPANY, BROOKLYN, N. Y.
CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
SOUTH BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CHARLESTOWN GAS-LIGHT CO., CHARLESTOWN, MASS.
LYNN GAS-LIGHT COMPANY, LYNN, MASS.
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GAS AND WATER VALVES ½ INCH TO 36 INCHES DIAMETER.
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357-tf

GAS COALS.

THE

PENN GAS COAL COMPANY

OFFER THEIR

COAL, CAREFULLY SCREENED,

AND PREPARED FOR

GAS PURPOSES.

Their Property is located in the Youghiogheny Coal Basin, near Irwin's and Penn Station, on the Pennsylvania Railroad, and on the Youghiogheny River.

OFFICES

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PLACES OF SHIPMENT.

Pennsylvania Railroad, Pier No. 2 (Lower Side).
Greenwich Wharves, Delaware River.
Pier No. 1 (Lower Side), South Amboy, N. J.

366-1y

CANNELTON COAL COMPANY,

OF WEST VIRGINIA.

Offer for sale the following Coals, from their Colliery at CANNELTON, Kanawha County, West Virginia delivered at RICHMOND, Va.:

CANNELTON CANNEL,

acknowledged to be the most valuable ENRICHER produced in this country, a gross ton yielding 10,000 cubic feet of GAS of 64·54 CANDLE POWER; COKE 32 bushels, of good quality.

CANNELTON CAKING COAL.

MAXIMUM YIELD, 5.06 cubic feet of Gas per pound of Coal—A yield of 4·78 cubic feet per lb.—gave 16 14-100 Candle-Power.

COKE, of very fine quality—1453 pounds produced from one ton of coal.

SALES AGENTS { J. TATNALL LEA, Treasurer, P. O. Box 1747 Philadelphia. PERKINS & JOB, 27 South Street, N. Y.; 91 State Street, Boston. H. W. BENEDICT & SON, New Haven.

THE WAVERLY COAL AND COKE CO.

Offer for Sale the

YOUGHIOGHENY COAL

DOUBLE SCREENED,

from their Colliery at Smith's Mills, on the Youghiogheny River, thirty-seven and a half miles southerly of Pittsburgh. This Coal has the preference in Pittsburgh over all other YOUGHIOGHENY COAL for GAS PURPOSES.

The facilities of the WAVERLY COMPANY are unsurpassed by those of any other Company on the Youghiogheny.

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The undersigned are prepared to execute orders for the

BLOCK HOUSE, GLACE BAY, CALEDONIA, and LINGAN COAL.

For delivery at any Port in the United States.

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NEW YORK AND CLEVELAND

GAS COAL COM'Y

Of Pittsburgh, Pa.

MINERS AND SHIPPERS OF

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This Company is prepared to furnish any amount of their justly celebrated, and acknowledged superior GAS COAL, to any point reached by railroad or navigation, on most favorable terms.

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Branch Office—C. & P. RR. Coal Pier, CLEVELAND, OHIO.

WILLIAM A. McINTOSH, President.
A. CARNEGIE, Vice-President.
W. P. DE ARMIT, Treasurer.
THOMAS AXWORTHY, Agent at Cleveland, Ohio.

351-1y

PEYTONA CANNEL COAL,

FROM WEST VIRGINIA.

Yields over 13,000 feet of Gas per ton. At ten thousand feet (standard yield) the illuminating power is over 43 candles. Purifies 4,510 feet to the bushel of lime.

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I. B. BRICE, Vice-President.
A. H. ALLEN, Secretary.
WM. J. VALENTINE, Treasurer.
GEORGE W. HARRIS, Engineer.

This Company is the owner of the GWYNNE-HARRIS, or AMERICAN HYDROCARBON process, for making Gas for Lighting or Heating purposes, by the perfect decomposition of superheated steam, under what is known as the

GWYNNE AND HARRIS PATENTS.

This process has been fully tested nearly 50,000,000 cubic feet of Gas having been made under it, and fully demonstrating the fact that it is the greatest improvement ever made in the manufacture of Gas, either for Lighting or Heating purposes. With half a ton of Anthracite Coal 150,000 cubic feet of Gas per day is made from three benches, and the labor is so small that one man can attend three or four benches.

The process can be put into either Coal or Oil Gas Works (or where both Coal and Oil are used) at small cost, without any interruption to the working of other benches. The Citizens Gas-Light Company of Brooklyn, after using it for more than seven months, have found it not only far better, but actually *cheaper* than atmospheric air in making Gas, with the use of "petroleum and its products."

Further information, and terms of sale of rights will be given, upon application to the Company 348-1y

Brooklyn Clay Retort

AND

FIRE-BRICK WORKS,

VAN DYKE STREET, BROOKLYN, N. Y.

EDWARD D. WHITE, Surviving Partner of the late firm J. K BRICK & CO. 402-1y

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A HALF INTEREST IN A SMALL GAS WORKS WILL be sold, or leased to a practical gas man. Two thousand feet of natural gas per day. Address

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FODELL'S

System of Bookkeeping

FOR GAS COMPANIES.

Price $5, which should be sent either in Check, P. O. Order, or Registered Letter.

Blank Books, with printed headings and forms on this system, will be supplied to Gas Companies, by applying to W. P. FODELL, Philadelphia, or

A. M. CALLENDER & CO.,
Office GAS-LIGHT JOURNAL, 42 Pine St., N.Y.

IMPROVED GAS EXHAUSTER,

WITH ENGINE ATTACHED ON SAME BED PLATE.

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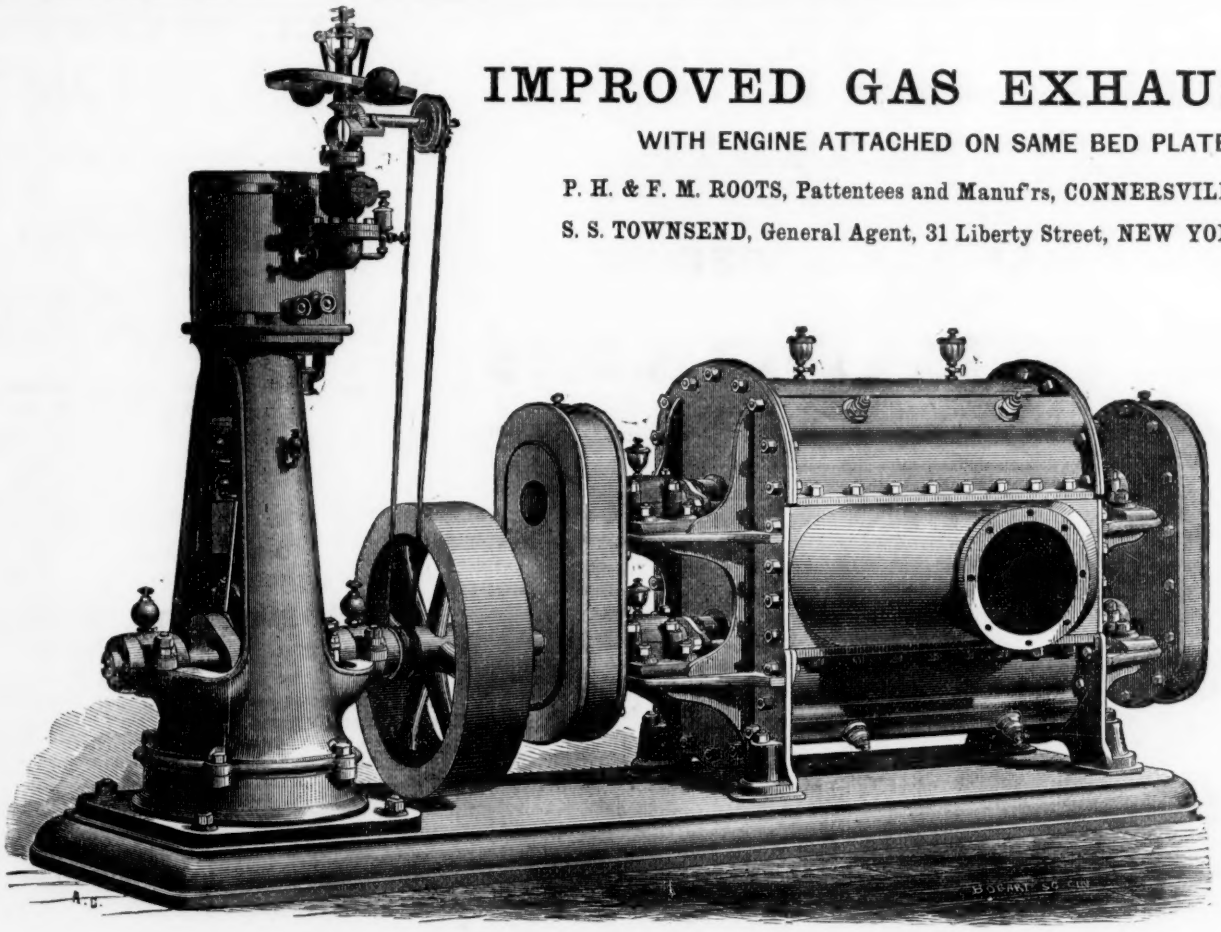
S. S. TOWNSEND, General Agent, 31 Liberty Street, NEW YORK.



ADVANTAGES CLAIMED FOR THIS EXHAUSTER.

1. It is simpler than any other Exhauster. The internal operating parts consist of only two pieces, cast entire, and can not get out of order.
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3. The revolvers, though practically gas-tight, do not run in actual contact, hence there is no friction, and a great saving of power effected.
4. They are built in the most complete and substantial manner, and of any required size, with steel shafts and improved journal bearings.
5. We furnish Exhausters and Engines combined on same Bed Plate, as shown above, or the Exhauster only, as may be required.
6. We also furnish Bye Passes and Gas Valves on improved plans, also Exhauster Governors and Elbows, Pipes, Drawings, etc.

Send for Illustrated Catalogue, giving details of capacity, speed, power required, price, and references to parties using them.

P. H. & F. M. ROOTS.

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Mines at Newburg, Preston County, W. Va.
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CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

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It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

224-1y n

THE DESPARD COAL COMPANY

OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

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Mines in Harrison County, West Virginia.
Wharves Locust Point, Company's Office, 15 German St., } Baltimore.

Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine.

*** Reference to them is requested. 204-

MANHATTAN

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RETORT WORKS.

ADAM WEBER,

(Successor to MAURER & WEBER.)

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Manufactures of

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Of all shapes and sizes.

FIRE MORTAR, CLAY AND SAND.

☞ Articles of every description made to order at short notice. 105

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N.B.—Pipes from 3-inch and upwards cast in 12 ft. lengths.

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MANUFACTURERS OF

Clay Gas Retorts,
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ALWAYS ON HAND.

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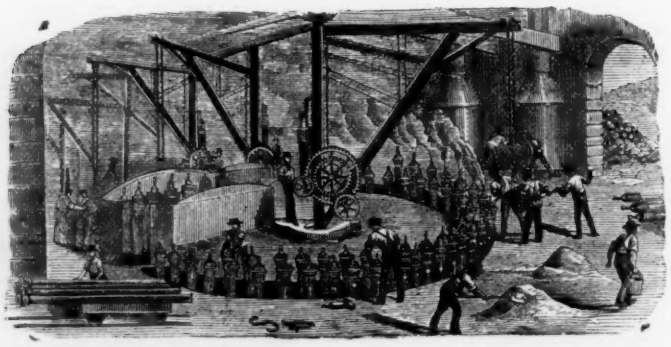
BURLINGTON. N. J,

Flange-Pipes



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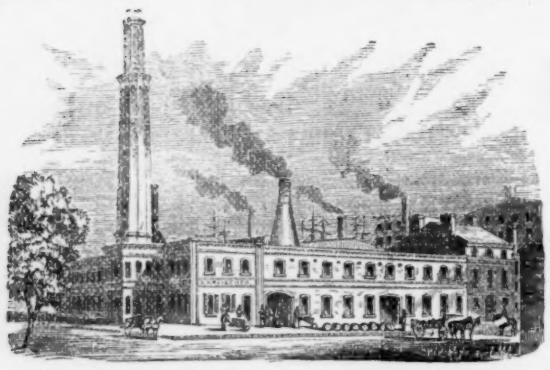

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Clay Gas Retorts

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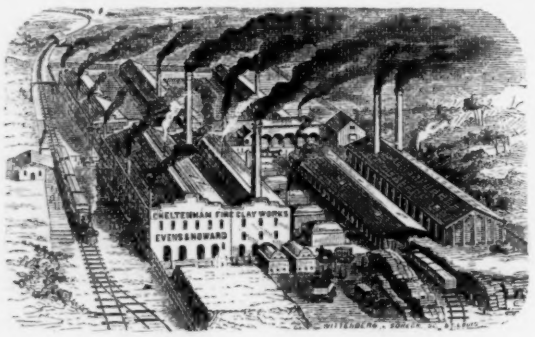

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Ground Fire

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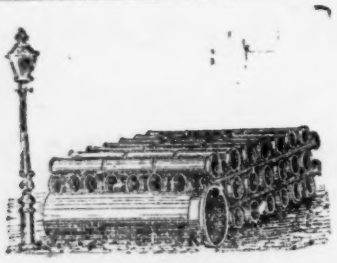

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Gas Consumers' Guide

Enables every Gas Consumer to ascertain at a glance, without any previous knowledge of the Gas Meter, the quantity and money value of the Gas consumed. Also the best method of obtaining from Gas the largest amount of its light.

It will be to the advantage of Gas Companies to supply their Consumers with one of these Guides, as a means of preventing complaints arising from their want of knowledge in regard to the registration of their meters. For sale by

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GAS ENGINEER AND CONTRACTOR

For the Erection, Alteration and Extension of Gas Works.

PLANS, SPECIFICATIONS AND ESTIMATES.

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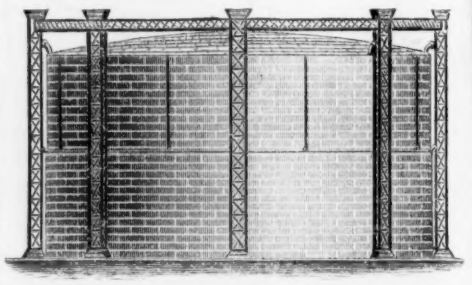

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Iron Roof Frames with Cornice Gutters, covered with Corrugated Iron or Slate; Iron Doors and Iron Pivot Blind Windows: Coke Barrows, Fire Tools, Retort Lids, Cotter Bars and Screws, Stop Valves, Tar Valves for Regulating Dip in Hydraulic Mains, Pressure Governors for Street Mains, and Compensators for Exhausters that are unrivalled for unvarying accuracy Steam Engines, Boilers, Etc. Etc.

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You can enrich your Coal Gas to any desired standard, by using my process, in the simplest manner, and much cheaper than by *any other* method.

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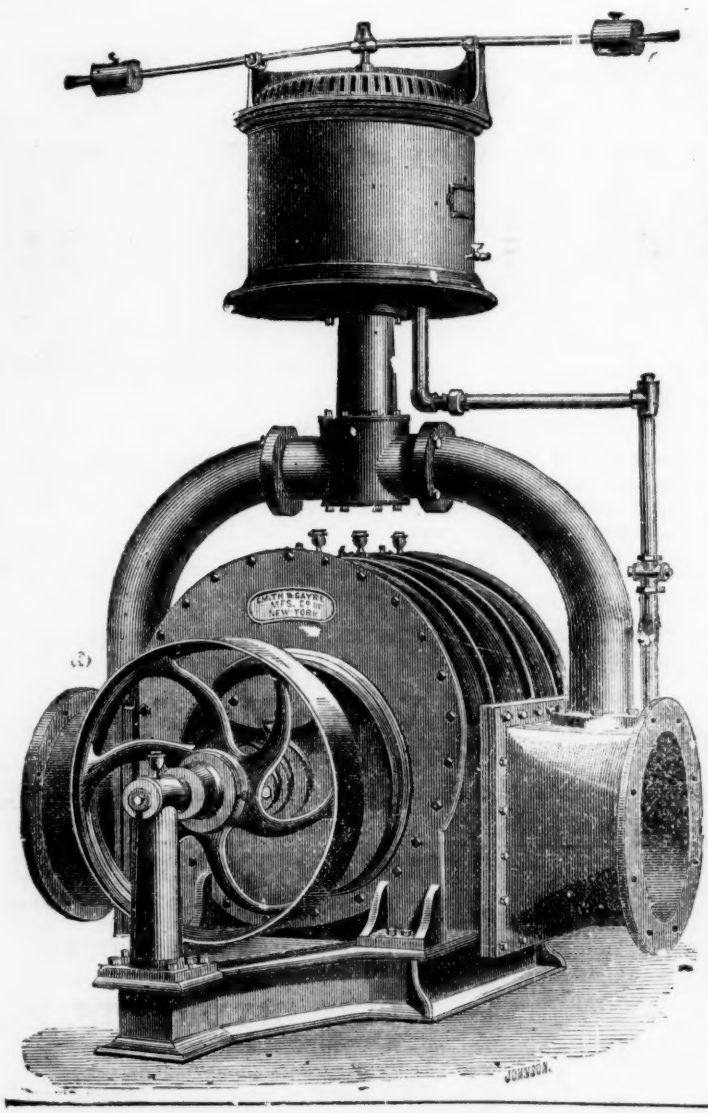
SMITH & SAYRE MANUFACTURING COMPANY.

The Mackenzie Patent Gas Exhauster

And Patent Compensator.



They are made to pass from 4,000 to 150,000 cubic feet of gas per hour; will increase the production and illuminating power of the gas and add very much to the durability of the retorts, either clay or iron. The Compensator obviates entirely the necessity of water-jo inis, is compact, durable, cleanly, not liable to get out of order, self-acting, quiet, and certain in its operation.

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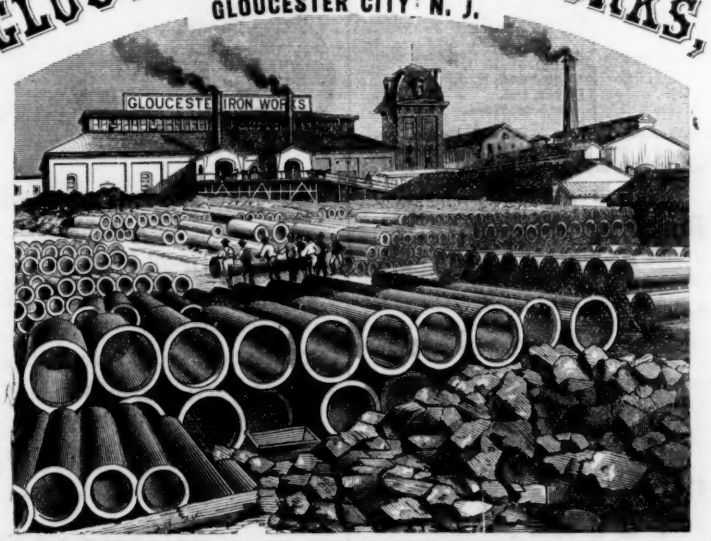

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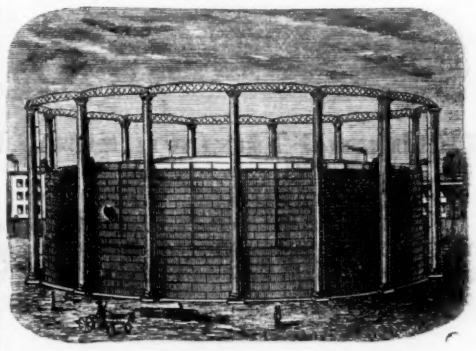

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Condensers, Scrubbers, Purifiers, Retorts, Hydraulic Mains, and all other articles connected with the Manufacture and Distribution of Gas, furnished with despatch. Plans and Specifications prepared, and Proposals given for the necessary Plans for Lighting Cities, Towns, Mansions, and Manufactories.

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ALL KINDS OF CASTINGS AND APPARATUS FOR GAS WORKS,

Wrought Iron Roof Frames,

For Retort and other houses. Retorts and all castings required for setting them in the latest and most improved model. WASHERS, CONDENSERS, SCRUBBERS and EXHAUSTERS for relieving the Retorts from pressure. PURIFIERS, varying from 2,000 to 2,000,000 cubic feet daily purifying capacity.

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With cast iron guide and suspension frames. GAS GOVERNORS or REGULATORS, STREET MAINS, from 1½ to 48 INCHES DIAMETER, for WATER or GAS. Street Main connections, such as BRANCHES, BENDS, DRIPS, SLEEVES, etc.

STOP VALVES, from 3 to 30 inches, for both Water and Gas.

Wrought Iron Work.

All the Smith and Sheet Iron work required in and about Gas Works. 226-tf

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SHIPPING POINT—Baltimore, Md.

This coa yields 10,000 cubic feet o fGas ,with an illuminating power of over 16 candles. Forty bushels of very superior Coke, with little Ash and scarcely any clinker 94-1y

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CHANDELIERS!

And Every Description of

GAS FIXTURES,

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Fine Gilt Bronze and Marble Clocks, warranted best Timekeepers Mantle Ornaments, &c.

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Special designs furnished for Gas Fixtures for Churches Public Halls, Lodges, &c.

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Attest—J. L. CAMPBELL, Secretary, pro-tem. Signed—A. T. GOSHORN, Director General J. R. HAWLEY, President.

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Oregon Iron Foundry

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ALL KINDS OF CASTINGS

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APPARATUS FOR GAS-WORKS.

BENCH CASTINGS
from benches of one to six Retorts each.

WASHERS: MULTITUBLAR AND AIR CONDENSERS; CONDENSERS; SCRUBBERS,

and dry), and

EXHAUSTERS
for relieving Retorts from pressure.

BENDS and BRANCHES
of all sizes and description.

FLOYD'S PATENT
MALLEABLE RETORT LID.

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FURNACE DOOR AND FRAME.

SELLER'S CEMENT
for stopping leaks in Retorts.

GAS GOVERNORS,

and everything connected with well regulated Gas Works, at low price, and in complete order.

N. B.—**STOP VALVES** from three to thirty inches—very low prices.

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THE LANE & BODLEY CO.,

MANUFACTURERS OF

HYDRAULIC ELEVATORS

We solicit specifications from Gas Companies for Hydraulic Elevators, of the Direct or Compound form, to be operated by Water from Street Main, or from Tanks supplied by pumps for this purpose. Address for circulars

THE LANE & BODLEY CO.,
John and Water Streets, Cincinnati.

We refer to William Farmer, Esq., Gas Engineer, No. 111 Broadway, N. Y

Cincinnati Gas-Light and Coke Co., three machines, Cincinnati; Laclede Gas Co., two machines, St. Louis, Evansville Gas Co., one machine, Evansville, Ind.; Newark Gas Co., one machine, Newark, N. J.; Pittsburg Gas Co., two machines, Pittsburg; Washington Gas Co., two machines, Washington, D. C. 414-1 y

1842. DEILY & FOWLER 1876.

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GAS HOLDERS,

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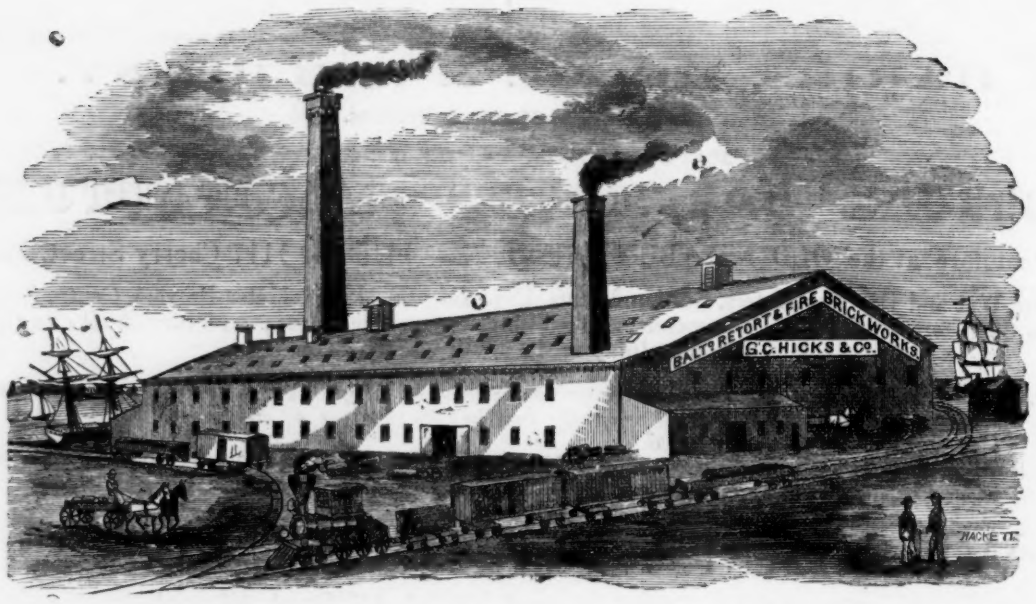

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"Yours truly, E. T. COX," *of the Centennial Jury of Awards.*